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ORIGINAL ARTICLES.

**THE CLINICAL SIGNIFICANCE OF GLYCOSURIA IN PREGNANT
WOMEN.**

By J. WHITRIDGE WILLIAMS, M.D.,

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I KNOW of no complication of pregnancy the significance of which is more variously interpreted than the presence of sugar in the urine of pregnant women. Certain writers regard it as a harmless almost physiological phenomenon, while others hold that it is always indicative of the existence of diabetes. Thus, Charrin, Brocard, Leduc, Salémi, and Bar state that a larger or smaller quantity of glucose can be demonstrated in the urine of from 40 to 66 per cent. of all pregnant women, and is, therefore, of no clinical significance. On the other hand Eshner, in 1907, collected the histories of 35 cases of diabetes complicating pregnancy, with a gross maternal mortality of 54 per cent. Moreover, it sometimes happens that the same case may be interpreted as a harmless and transient glycosuria, or as a mild case of diabetes, according to the point of view of the writer.

This divergence of opinion is in great part due to the influence exerted upon medical thought by a paper upon puerperal diabetes, which J. Matthews Duncan read before the London Obstetrical Society in 1882. At that time he collected from his own experience and the literature the histories of 22 pregnancies occurring in 16 women who had become pregnant while suffering from diabetes, or who had developed the disease during the course of pregnancy. Four died in coma or collapse within a few days after delivery and 7 others perished from diabetes or tuberculosis within the following two years, while 47 per cent. of the children were lost. He therefore

concluded that diabetes constituted one of the most serious complications of pregnancy, and his views were accepted without question, so that the practitioner, and even the obstetrical specialist, has come to regard the presence of sugar in the urine of pregnant women as of most serious prognostic import.

During the last five years I have seen a number of cases of glycosuria complicating pregnancy, and desire upon this occasion to call attention to my experience, and, after reviewing the literature upon the subject, to draw certain conclusions which I hope may be of practical value.

CASE I.—*Lactosuria in Pregnancy.* Mrs. H. J. B., aged thirty years, pregnant for the fourth time. Definite reduction with Fehling's solution occurred in the seventh lunar month, continued at intervals until the birth of the child, and disappeared entirely after the tenth day of the puerperium. The sugar varied between 1 and 2 per cent. in amount and did not undergo fermentation. At no time were any untoward symptoms noticed. An 8½-pound child was born after an operative labor; the puerperium was normal. Sugar did not reappear in the course of the following two years.

CASE II.—*Transient Glycosuria in Pregnancy.* Mrs. J. M. K., aged twenty-five years, pregnant for the first time. Three months before labor sugar appeared in the urine, and was demonstrated repeatedly during a period of three weeks, after which it disappeared spontaneously and did not return. It varied from 0.5 to 1 per cent. in amount, and readily underwent fermentation. There were no symptoms and the daily output of urine varied between 1200 and 1800 c.c. An 8½-pound child was delivered after an easy low-forceps operation; the puerperium was normal. Sugar did not reappear in a subsequent pregnancy three years later.

CASE III.—*Transient Glycosuria in Pregnancy.* Mrs. G. D. P., aged forty-three years, a stout woman, pregnant for the sixth time. Specimens of urine examined during the fourth and fifth months were normal. About the middle of the sixth month she began to complain of considerable thirst, and stated that her appetite was abnormally large as compared with that noted in previous pregnancies. The urinary output varied between 1500 and 2000 c.c. and contained from 1.3 to 2 per cent. of glucose on ordinary diet. Upon placing her upon an antidiabetic diet the sugar did not entirely disappear, but decreased to about 0.125 per cent., becoming abundant whenever a more liberal diet was permitted. The symptoms gradually subsided, although traces of glucose could be detected up to the time of labor, but disappeared permanently during the puerperium, being entirely absent from a specimen examined on the tenth day. The labor and puerperium were normal and the child weighed 8¾ pounds.

CASE IV.—*Alimentary Glycosuria in Pregnancy.* Mrs. D. K. B.
(a) The patient when first seen was twenty-four years of age and in

her second pregnancy. Two months before labor the presence of sugar was demonstrated upon repeated occasions, and, after persisting for six weeks, passed off spontaneously. There were no symptoms, and the daily output of urine varied from 1500 to 2000 c.c. The sugar varied between 0.25 and 1 per cent. in amount, and consisted of a mixture of glucose and lactose; as positive results were obtained both by the polariscope and by fermentation, the former indicating a much larger quantity of sugar than the latter. After a spontaneous labor she gave birth to a live child weighing $8\frac{1}{4}$ pounds, and had no further trouble until the next pregnancy. (b) Three years later she became pregnant for the third time and sugar made its appearance during the seventh lunar month, persisting in varying quantities up to the birth of the child. She presented no symptoms and passed in twenty-four hours from 2000 to 2500 c.c. of urine, which contained from 0.25 to 1 per cent. of glucose. Its quantity remained unchanged no matter whether she was upon an ordinary or a carbohydrate-free diet. On discussing the matter with the patient I found that she had suffered from constipation for years and used senna prunes for its relief. These were prepared by stewing one pound of prunes in a decoction of a handful of senna leaves in a quart of water, to which one pound of sugar was added, which was then evaporated down to a thick syrup. Each night she took one-half dozen or more of prunes with considerable quantity of the syrup. It occurred to me that the glycosuria might possibly be due to the fact that she was unable to assimilate this extra amount of sugar. This supposition was found to be correct, as all trace of sugar disappeared from the urine upon replacing the prunes by a simple purgative, but it would promptly reappear as soon as their use was resumed. In this instance it appeared that the patient was intolerant of sugar administered in this form and suffered from alimentary glycosuria whenever it was used, but at the same time was able to assimilate the carbohydrates in her ordinary diet. She gave birth to an $8\frac{1}{4}$ -pound child after a normal labor, and no trace of sugar could be found after the puerperium.

CASE V.—*Recurrent Glycosuria during Pregnancy.* Mrs. J. T. H. (a) She became pregnant for the first time when twenty-nine years of age. The pregnancy was perfectly normal up to the seventh month when glycosuria appeared and continued until the time of labor, but gave rise to no symptoms. The amount of glucose varied from a mere trace to 0.5 per cent. and was uninfluenced by diet. A well-developed child was born after a normal labor and no trace of sugar could be detected during lactation. (b) The second pregnancy began eleven months after the birth of the first child. Sugar was detected at the second month and persisted in varying quantities until the time of labor. It varied from a mere trace to 1 per cent. and was definitely shown to be glucose. The glycosuria was not influenced by diet and gave rise to no symptoms. Pregnancy and

labor were uneventful and the sugar disappeared immediately after the latter. (c) Her third pregnancy occurred four years after the birth of the second child. Repeated examination showed that the urine was free from sugar up to the sixth month, at which period it made its appearance and persisted up to the time of delivery. Chemical examination showed that it was definitely glucose, and ordinarily varied between 0.25 and 0.5 per cent. The glycosuria was not influenced by carbohydrate-free diet, and gave rise to no symptoms; acetone bodies were at no time present. The patient passed through a normal pregnancy, labor, and puerperium, and no trace of sugar could be found later.

CASE VI.—*Mild Diabetes complicating Pregnancy.* Mrs. L. W., aged twenty-nine years, came to the hospital in the seventh month of her second pregnancy, her physician having discovered the existence of glycosuria a few weeks previously. She complained of frequent micturition and stated that she was obliged to drink large quantities of water on account of excessive thirst, but had observed no other symptoms. On the day of admission she passed 1000 c.c. of urine which contained 2.5 per cent. of glucose. The glycosuria disappeared entirely upon a milk diet, but reappeared when she was placed upon a restricted ward diet, the urine containing 0.46 to 0.50 grams of glucose per liter. After remaining in the hospital for two weeks she was dismissed in good condition with instructions as to diet. Her physician has kindly informed me that she remained in good condition during the rest of her pregnancy upon a restricted diet, and had a normal labor at term. Six months later her urine contained 3 per cent. of glucose with a specific gravity of 1044. She presented no symptoms and would have been unaware of her condition were it not for the fact that she was kept under constant supervision and upon a restricted diet.

The histories which I have briefly given serve as examples of the various conditions in which sugar may be observed in the urine of pregnant women. Thus in Case I we had to deal with simple lactosuria, in Cases II and III with transient glycosuria, in Case IV with alimentary glycosuria, in Case V with recurrent glycosuria, and in Case VI with mild diabetes. With the exception of the latter, all of the cases were observed in private practice.

By way of comparison I have gone over the urinary records of 0300 consecutive patients in the Obstetrical Department of the Johns Hopkins Hospital. In this series the urine was examined as a matter of routine by the assistant or student on duty at weekly intervals, except for a catheterized specimen obtained immediately after labor, and the presence of sugar was recorded only when a definite reduction was obtained with Fehling's solution. Judged by this criterion, sugar was demonstrated in 167 patients during pregnancy, labor, or the puerperium, a frequency of 5.57 per cent.

The incidence in the several periods was as follows: Pregnancy alone, 24 cases (0.8 per cent.); puerperium alone, 137 cases (4.57 per cent.); and in both pregnancy and puerperium, 6 cases (0.2 per cent.).

Upon analyzing the cases in which the presence of sugar was demonstrated only during pregnancy, it is found that it was noted in 12 instances two weeks before labor, in 6 instances between two and four weeks before labor, in 4 instances between four and eight weeks before labor, and in 2 instances during the sixth and seventh months of pregnancy, respectively. The last 2 cases were examples of definite glycosuria, one being the case of diabetes whose history was given above (Case VI); while unfortunately no particulars can be given concerning the other, as she insisted upon leaving the hospital after a stay of only a few days, and has not been heard from since. It may be assumed that the majority of the other 22 cases were examples of lactosuria, as in no instance in which the nature of the sugar was determined was it found to be glucose. Moreover, its appearance so late in pregnancy would indicate that it was associated with premature mammary activity. Likewise, in all probability, we had to deal with lactosuria in the six cases in which a reduction was obtained both in pregnancy and the puerperium, as in each instance sugar appeared only shortly before labor, but unfortunately its exact nature was not determined.

In all of the 137 cases in which the presence of sugar was demonstrated only during the puerperium, we presumably had to deal with lactose. This belief is based upon the fact that the condition was usually associated with abnormalities in the mammary secretion, and furthermore that fermentation failed to occur in any of the cases subjected to that test, although of course it is possible that occasionally it may have been combined with glucose; but positive statements cannot be made in this regard, as in no instance were the characteristic osazones isolated.

Naturally, the 167 cases here mentioned do not represent the actual incidence of the presence of sugar in the urine during the last weeks of pregnancy and the first two weeks of the puerperium, for the reason that the examinations were made only once a week and a positive result recorded only when a definite reduction was obtained with Fehling's solution. Doubtless, a much greater incidence would have been indicated had daily examinations been made with more delicate reagents.

I shall now turn to the literature upon the subject and shall consider separately each of the following conditions: (a) Lactosuria; (b) transient glycosuria; (c) alimentary glycosuria; (d) recurrent glycosuria; and (e) diabetes.

Lactosuria. Although the presence of sugar in the urine of puerperal women was mentioned by Heller in 1849, it was first brought prominently to the attention of the profession in 1856, by Blot, who

stated that he had been able to demonstrate it in amounts varying between 1 and 2 grams per liter in 45 consecutive women who suckled their children. He held that its presence was dependent upon the functioning of the breasts and that its quantity served as an index of the abundance of the milk supply. Moreover, he stated that sugar could be found in the urine of about 50 per cent. of women in the last weeks of pregnancy. Unfortunately, he designated the condition as "physiological glycosuria," but did not attempt to determine whether the sugar in question was glucose or lactose. This communication aroused great interest and gave rise to a discussion which has extended to the present time.

Blot's statements were promptly tested by a number of investigators, some of whom absolutely denied their correctness and attributed his results to faulty technique, while others confirmed them more or less fully. Thus, Wiederhold, Leconte, Capezzuoli, Riedel, Iwanoff, and others stated that sugar was not present under such circumstances and that the reduction of the copper solution, which had been attributed to it, was due to the presence in the urine of mucus, uric acid, creatinin, or other substances. On the other hand, De Moulins, Kirsten, Brücke, Lecoq, Chailly, Louvet, Hempel, De Sinéty, Gubler, and Johannovsky demonstrated the presence of sugar in the urine of a varying proportion of puerperal women.

It is interesting to note that De Moulins, Wiederhold, Lecoq, and others suggested that the sugar in question might be lactose, while De Sinéty demonstrated that it disappeared in animals upon amputating the breasts and failed to appear after subsequent labors. Moreover, all investigators who obtained positive results were united in stating that the largest quantities of sugar were noted in women who did not suckle their children or in whom the breasts had become engorged from one cause or another, and accordingly attributed it to resorption. Consequently they concluded that Blot's contention was erroneous concerning the value of the condition as an index of mammary activity.

In 1877 and 1879 Hofmeister and Kaltenbach, respectively, isolated the sugar in question and definitely showed that it was lactose, thereby conclusively demonstrating that the condition was one of lactosuria, and that the term glycosuria was a misnomer. They held that the condition in all probability was due to the resorption of lactose from the milk in the more or less engorged breasts, and was, therefore, associated with their imperfect functioning. The suggestion of Luther that milk sugar, which thus gained access to the blood current, did not pass through the portal system, as well as the demonstration by Moritz and Voit that it was excreted unchanged through the kidneys when injected directly into the circulation, whereas it was utilized for metabolic purposes when administered by the mouth, afforded a thoroughly satisfactory explanation for the production of the phenomenon.

Notwithstanding the demonstration of the nature of the sugar in these cases, the majority of subsequent writers failed to make use of the term "puerperal lactosuria," but continued to designate the condition as glycosuria, puerperal diabetes, or resorption diabetes, as the case might be, and thereby materially retarded the general recognition of its true significance. Following the establishment of the mode of production of puerperal lactosuria, all investigators, who have made daily examinations of the catheterized urine of puerperal women, have been able in most cases to demonstrate the presence of traces of lactose at some time during the first few days of the puerperium, as well as considerable quantities whenever the breasts became engorged or the child was weaned. Observations of this character have been made by McDonald, Davenport, Ney, McCann and Turner, Lemaire, Keim, Leduc, Queirel and Domergue, Commandeur and Porcher, and others.

In view of these findings, the existence of slight degrees of lactosuria (0.5 to 1 gram per liter) in the early days of the puerperium may be regarded as perfectly physiological, while the presence of larger quantities (10 to 30 grams per liter) may be expected whenever the breasts become engorged or the child is weaned. The fact that sugar was found in only 143 out of 3000 puerperal urines in my service should not be regarded as invalidating this statement, for two reasons: In the first place, as our urines were examined only once a week, such a transient phenomenon occurring between the second and fourth days would frequently escape detection; and, secondly, as the examinations merely formed a part of the routine duties of the assistant on duty, it is highly probable that only such cases would be reported which presented a perfectly typical reduction with Fehling's solution, which is not observed unless at least 1 per cent. of sugar is present.

In this connection it is important to direct attention to the diagnostic significance of lactosuria accompanying the process of weaning the child, as in such cases the quantity of sugar may rise as high as 3 or 4 per cent. and persist until the secretion has been checked and the breasts have become soft and flabby. For this reason, the detection of sugar in the urine of a nursing woman who has just weaned her child in order to enter a hospital, for example, should not lead to the diagnosis of diabetes until the nature of the sugar has been definitely determined: as it may readily happen that failure in this regard may lead to the postponement of a necessary operation or to erroneous conclusions concerning the prognostic significance of diabetes complicating surgical procedures. Attention was first directed to this fact by Sir W. J. Sinclair as early as 1886.

Lactosuria of Pregnancy. The observations of Bar, Brocard, Bürgers, Commandeur and Porcher, Ludwig, Naunyn, and others have clearly shown that by appropriate means slight degrees of lactosuria may also be detected during the last weeks of pregnancy

and is usually associated with premature mammary activity. Thus, Ludwig noted it in 46 per cent. of 82 women in the last weeks of pregnancy, while in 10 per cent. more of his patients lactose alternated with glucose. Commandeur and Porcher found lactosuria in 30 consecutive cases, although in 8 instances it was associated with glycosuria. In the latter event they believe that the condition is due to the fact that the breasts are not sufficiently active to convert into lactose all of the glucose which is brought to them by the blood, as they hold that such a transformation usually occurs as soon as the breasts begin to function. Moreover, they consider that both they and Bert have adduced experimental evidence in support of such a transformation by finding that the urine of recently delivered goats, whose breasts had been amputated just before conception, contains considerable quantities of glucose in place of the lactose which is usually present.

In 22 of the 24 cases in which sugar was present during pregnancy in the urine of 3000 consecutive patients in my service, it is probable that we had to do with lactosuria, as in none of them was the presence of sugar demonstrated prior to the last six weeks of pregnancy and usually only during the two weeks immediately preceding delivery. Moreover, only lactose was found in the cases in which the nature of the sugar was differentiated. On the other hand, Case I clearly shows that lactosuria does not occur exclusively in the last weeks of pregnancy, as in this instance milk sugar was definitely demonstrated during the course of the seventh month, and doubtless many similar cases have occurred in the experience of others.

In consideration of the facts just adduced, I feel that one is justified in stating that moderate degrees of lactosuria occurring either during pregnancy or the puerperium may be regarded as physiological and, therefore, of no prognostic significance. The practical importance of the condition lies in the fact that an incautious observer may confound it with glycosuria and, believing that the latter is indicative of the existence of diabetes, may express a sombre prognosis, which is usually not justifiable.

Transient Glycosuria. Leaving out of consideration the minute amounts of glucose which have been shown by the observations of Brücke, Ivanoff, Abeles, Pavy, Luther, Moritz, Lemaire, and others to be present in the urine of normal men and women, certain authors also state that appreciable quantities of glucose may be demonstrated in the urine during the second half of pregnancy and particularly during its last few weeks. The following authors make varying statements concerning its incidence: Keim, 10 per cent.; Ludwig, 12 per cent.; Ney, 16.6 per cent.; Commandeur and Porcher, 26 per cent.; Charriin, 40 per cent.; Bar, 43 per cent.; Brocard, 45 per cent.; Leduc, 60 per cent.; Salémi, 66 per cent.; while Rudaux holds that its presence is practically universal, and Brocard and Bar state

that glycosuria is observed much more frequently in multiparous than primiparous women.

Manifestly, in such cases the amount of glucose is very small, varying from 1 to 2 or 3 grams per liter, and consequently must be tested for by delicate reagents, as the presence of at least 1 per cent. is necessary in order to give a characteristic reduction with Fehling's solution. On the other hand, it not infrequently happens that larger quantities may be observed during pregnancy and yet have no connection with diabetes. This is clearly demonstrated by the histories of Cases II and III, as well as by many other instances which might be adduced from the literature. Exceptionally, the amount of sugar may rise as high as 3 or 4 per cent., and even give rise to slight symptoms, such as pruritus, increased thirst, and frequent urination, although subjective manifestations are usually absent. In either event, the glycosuria may disappear spontaneously after a longer or shorter period, or may persist throughout the balance of the pregnancy to disappear definitely after the birth of the child. It would appear that many physicians, being ignorant of the possibility of such an occurrence, have described cases of this character as examples of true diabetes, and it would seem that the cases described as such by Partridge, Taylor, Durieux, and others might be placed in this category.

Unfortunately, it is frequently impossible in a given case to determine immediately whether the presence of sugar is merely an evidence of transient glycosuria or of mild diabetes, and in many instances an assured diagnosis can be made only after the conclusion of pregnancy. If the condition is merely transient glycosuria, all traces of sugar promptly disappear after delivery and there are no further symptoms; whereas in diabetes the glycosuria persists and in many instances the symptoms become aggravated. The importance of recognizing the existence of transient glycosuria and of not confusing it with diabetes has been strongly insisted upon by Naunyn, Senator and Kamminer, Salus, Brook, and others. Very exceptionally the condition may still further simulate diabetes, particularly as it is sometimes associated with hydramnios, as in the cases reported by Rossa in which the maternal urine contained 0.92 per cent. of glucose, while 0.345 per cent. was present in the amniotic fluid.

On inquiring as to the significance of transient glycosuria, it may be said that the milder degrees (1 to 2 grams per liter) should be regarded as practically physiological, while, on the other hand, the occurrence of larger quantities must be considered abnormal, although as far as our knowledge at present goes, not necessarily of clinical significance.

The most important practical point in connection with this condition, however, is to realize that it does occur, and that it is even quite common. Therefore, when the presence of glucose is demonstrated in the urine of pregnant women, diabetes should not be

diagnosticated, unless the sugar is present in large amounts and is accompanied by definite symptoms. Unfortunately, as has already been indicated, it is frequently impossible to differentiate between the two conditions until after delivery, as was clearly demonstrated in Cases III and IV. In both instances 2 per cent. of glucose was observed during the course of pregnancy and gave rise to no symptoms. In Case III the sugar disappeared immediately after delivery, while in Case IV it did not, but actually increased in amount, thus indicating that the former was an example of transient glycosuria and the latter of mild diabetes. The mode of production of this variety of glycosuria will be taken up under the following heading:

Alimentary Glycosuria. In 1895 Lanz and von Jaksch pointed out that women were less tolerant of sugar during pregnancy than at other times, and that transient glycosuria frequently followed the ingestion of an amount of glucose which would have been thoroughly assimilated by a non-pregnant woman. Investigations upon similar lines have since been undertaken by Keim, Brocard, Payer, Ludwig, Combemale and Oui, Charrin and Guillemonat, Schroeder, Rudaux and Bar, all of whom, with the exception of Ludwig, have more or less fully confirmed the findings of Lanz and von Jaksch. Thus Brocard administered to 17 pregnant women varying quantities of glucose before breakfast, and was able to demonstrate its presence in the urine in a varying proportion of cases within the course of the following two hours. He also found that alimentary glycosuria sometimes occurred in non-pregnant women, but far less frequently. The following table gives an idea of the varying effect of increasing doses of sugar in the two conditions:

	Per cent. of pregnant women.	Per cent. of non-pregnant women.
50 grams caused glycosuria in	50	11
80 grams caused glycosuria in	70	15
100 grams caused glycosuria in	70	16
150 grams caused glycosuria in	88	19
200 grams caused glycosuria in	100	29

Payer likewise experimented upon 45 pregnant women, 35 of whom manifested alimentary glycosuria, the average amount of glucose necessary to give rise to the phenomenon being 130 grams in pregnant, as compared to 200 grams in non-pregnant women. Schroeder, in 1905, performed similar experiments with levulose, and after a dose of 150 grams administered before breakfast obtained positive results in 17 out of 95 women. Moreover, it is important to note that all but 2 of his positive cases presented moderate degrees of albuminuria, which was of a very high grade whenever the levulosuria was marked. Combemale and Oui, and Bar have also observed more or less similar results following the administration of

cane sugar. Bar, who conducted a most careful series of experiments, calculated the amount which could be assimilated for each kilogram of the patient's weight, and found that the power of assimilation was greatly reduced during pregnancy; his experiments showed that glycosuria would follow the administration of 6 to 8 grams of sugar per kilo of body weight in pregnant as compared to 12 or 13 grams in non-pregnant individuals.

There is no doubt that alimentary glycosuria occurs comparatively frequently in practice and has occasionally been described as diabetes. Case IV was a striking example of this condition, and in it the glycosuria could be made to appear or disappear according as senna prunes were used as a laxative or not.

Numerous theories have been advanced in explanation of this phenomenon, and, while none of them are entirely satisfactory, we are obliged to reckon with the fact that the pregnant woman is less tolerant of sugar than at other times, and that, therefore, the practitioner will occasionally have to deal with cases of alimentary glycosuria. Moreover, it is quite possible that the same factors which are concerned in its production apply equally well to transient glycosuria.

Keim and others have advanced the theory that glycosuria in pregnancy is merely a manifestation of a toxemia. They hold that the latter is associated with disturbed function of the liver, by which the conversion of glucose into glycogen may be interfered with, thus leading to the production of glycemia and consequent glycosuria. Schroeder takes a somewhat similar view, which is based upon the fact that albuminuria was present in 15 out of 17 cases in which he was able to produce alimentary levulosuria. As he believes that the albuminuria of pregnancy is associated with abnormalities in the function of the thyroid gland, he is inclined to attribute the lessened power of assimilation of sugar to some similar derangement, although his view has not been accepted by most writers upon the subject. Brocard, on the other hand, holds that glycosuria is merely an expression of a diminished necessity for the consumption of carbohydrates during pregnancy, while Bar contends that it is a manifestation of a diminished power of assimilation. It is apparent, however, that these explanations are of but little value, as they throw no light upon the ultimate factors underlying the disturbed metabolism.

Rudaux, and Commandeur and Porcher associated the production of glycosuria with the mammary function. Rudaux believes that large quantities of glycogen are stored up in the liver and other organs in anticipation of lactation. Consequently, when this has been accomplished beyond a certain extent it becomes impossible for the usual amounts of glucose to be transformed into glycogen and thus be removed from the circulation, so that it becomes necessary for the excess to be excreted through the kidneys. Commandeur and Porcher, on the other hand, attribute the condition to lack of function

on the part of the breasts; they believe that during lactation the latter convert into lactose large quantities of glucose brought to them by the blood, and that normally this function becomes inaugurated in the last weeks of pregnancy. In connection with these theories, the observations of Charrin and Guillemonat are of interest, as they have apparently definitely shown that the liver cells of pregnant guinea-pigs contain far more glycogen than usual. They attribute this to lessened consumption, and hold that the overloaded cells are unable to take up the usual quantity of glucose from the blood and consequently glycemia and subsequent glycosuria must result.

Hofbauer, in his important recent contribution to our knowledge of the toxemias of pregnancy, studied the livers of several perfectly normal pregnant women who died from traumatism, and in each instance discovered characteristic changes in the liver cells, which he believes are normally associated with pregnancy. These consist in more or less fatty degeneration of the peripheral portions of the lobules, associated with a marked diminution in the glycogen content. If his observations hold good, it would appear that the cause of glycosuria must be sought in some abnormal condition of the liver cells resulting from pregnancy which interferes with the storage of glycogen in the ordinary quantities, so that the portion of sugar which should be so transformed must of necessity circulate in the blood and be excreted through the urine. It is interesting to note that Cristalli advanced a somewhat similar explanation in 1900.

Notwithstanding the large amount of work which has been done upon the subject, it is apparent that we are as yet unable to give a satisfactory explanation for the production of either transient or alimentary glycosuria, but at the same time it must be admitted that their occurrence is a fact which must be reckoned with and is of great diagnostic importance. In the present stage of our knowledge it would seem permissible to diagnose alimentary glycosuria in any case in which the sugar disappeared from the urine upon removing excessive quantities of sugar from the diet, while not restricting other forms of carbohydrate food.

Recurrent Glycosuria. Case V is a typical example of this condition. The patient presented glycosuria in three consecutive pregnancies, which varied in amount from a fraction of 1 to 2 per cent.; it gave rise to no symptoms, was not influenced by diet, disappeared after labor, and reappeared in each subsequent pregnancy.

It is interesting to note that two of the earliest cases described as diabetes in pregnant women were presumably of the same character, namely, those reported by Bennewitz and Lever in 1826 and 1847, respectively. Matthews Duncan was acquainted with the condition and drew from it the conclusion that "diabetes may occur only during pregnancy, being absent at other times." Likewise, Partridge, in 1895, in describing what he considered to be a case of diabetes complicating pregnancy, but which was probably only

an example of transient glycosuria, stated among other conclusions, that "diabetes may originate during pregnancy, persist throughout its course, and disappear on its completion to reappear in a subsequent pregnancy." Somewhat similar cases have been reported by Ruoff and Tate. In the former case 4 to 7 per cent. of sugar was present in the second, fourth, and fifth pregnancies, but disappeared during the puerperium in each instance. In Tate's case sugar was present in the second and third pregnancies and disappeared after the birth of the child.

It is difficult to speak positively concerning the significance of such cases. In those described by Bennewitz and Ruoff, the patients presented definite diabetic symptoms during pregnancy, and excreted large amounts of sugar, but the fact that the condition cleared up immediately after delivery and gave no further trouble until the occurrence of a subsequent pregnancy, would strongly militate against its diabetic nature. On the other hand, in the case reported by Tate, as well as in my Case VI, there were no symptoms and the condition was discovered simply on account of the routine examination of the urine. Whatever may be thought of the first group of cases, it seems clear that the latter group cannot be classified as diabetes, and is best described as recurrent glycosuria. At the same time it is probable that they should be regarded as of a more serious nature than ordinary transient or alimentary glycosuria, in that they probably indicate the existence of a more profound and continuous disturbance of metabolism.

Diabetes. Our knowledge upon this subject practically began with Duncan's paper in 1882, which was based upon the study of 22 pregnancies occurring in 16 women. Four of these died in coma or collapse at the time of labor, and 7 others perished from diabetes or tuberculosis in the course of the following two years, while 47 per cent. of the children were either born dead, succumbed during labor, or died early in the puerperium. As the result of his investigations he held that the association of pregnancy and diabetes was a most serious complication and formulated the following conclusions: (1) "Diabetes may come on during pregnancy." (2) "Diabetes may occur only during pregnancy, being absent at other times." (3) "Diabetes may cease with the termination of pregnancy, recurring some time afterward." (4) "Diabetes may come on soon after parturition." (5) "Diabetes may not return in a pregnancy occurring after its cure." (6) "Pregnancy may occur during diabetes." (7) "Pregnancy and parturition may be apparently unaffected in its healthy progress by diabetes." (8) "Pregnancy is very likely to be interrupted in its course and probably always by the death of the foetus."

Considering these conclusions in the light of our present knowledge, it would appear that the conditions described under conclusions 2 and 5 probably possessed no points in common with diabetes,

except the presence of sugar in the urine, and were merely examples of transient, alimentary, or recurrent glycosuria. Moreover, as will be shown farther on, Duncan apparently took a somewhat too serious view of the dangers of true diabetes when associated with pregnancy.

Such a point of view can be readily understood, when it is remembered that at the time at which he wrote very few physicians were in the habit of examining the urine of apparently normal pregnant women at frequent and regular intervals, and made such examinations only in the presence of more or less serious symptoms. Consequently the majority of the cases of simple glycosuria must have escaped detection, and practically only the more serious forms of true diabetes were diagnosticated. That this interpretation is justifiable is shown by the fact that none of the six cases reported in this article would have been recognized had the frequent examination of the urine not formed part of the routine care of all pregnant women. On the other hand, as has already been indicated, Duncan's series of cases included several examples of non-diabetic glycosuria, which were probably more or less accidentally discovered and described as diabetes in the absence of more precise information. Indeed it may be said that all statistics upon the subject have suffered from this defect, as the authors in their anxiety to collect a large series of cases have included a number of questionable significance.

From my own experience and a study of the literature I feel that the significance of diabetes associated with pregnancy may be profitably discussed under following headings: (*a*) Pregnancy may occur in definitely diabetic women. (*b*) Diabetes may be first recognized during pregnancy and persist afterward. (*c*) Diabetes may first appear during pregnancy and disappear afterward. (*d*) Diabetes may recur in each pregnancy and disappear after each delivery. (*e*) Diabetes may exist before and after pregnancy, but disappear during its course.

There can be no doubt as to the significance of the conditions described under the headings *a* and *b*, as in them the existence of diabetes can be readily established. The same may be said of group *c*, although the case described by Stengel is at present the only one belonging in the category. On the other hand, the diabetic nature of the conditions included in groups *c* and *d* is open to discussion, as they probably merely represent exaggerated examples of transient, recurrent, or alimentary glycosuria. Skepticism in this regard is justified by our conception of diabetes as a chronic, practically incurable disease, in which glucose is never long absent from the urine; therefore it would not appear permissible to describe as such, conditions in which the sugar permanently disappears.

One of the great merits of Duncan's work was that it clearly proved that pregnancy might occur in women suffering from diabetes, and thus did away with the old view that they were absolutely sterile.

At the same time it is generally admitted that the probability of conception becomes markedly diminished in such cases, partly because the disease usually occurs after the menopause, but more especially as the researches of Loeb, Hofmeier, Nebel, Seegen, Lecorché, and others have shown that it may be associated with profound changes in the internal genitalia. These may vary from a simple endometritis to marked atrophic processes in the ovaries or in the uterus, by which the ova are destroyed *in situ* or the uterus rendered unfit for their proper implantation and nutrition.

It is probably in great part due to partial persistence of the older view that most writers state that diabetes occurs much more frequently as a complication of pregnancy than that conception takes place in diabetic women. Thus Eshner, in 1907, stated that the latter occurred in only 8 out of 33 cases. On the other hand, I am inclined to hold that such a belief is erroneous and is based upon incorrect interpretation. The mere fact that the presence of sugar was first detected during the course of pregnancy by no means proves that it had not been present previously, but merely indicates that the condition was not accompanied by symptoms sufficiently severe to make it necessary for the patient to consult a physician. In such cases a diagnosis would not have been made had not the occurrence of pregnancy lead to the examination of the urine, just as it frequently happens that the existence of diabetes is unexpectedly discovered in men applying for life insurance, who had previously believed that they were in perfect health.

The accompanying table, which is based upon the histories of 66 definite cases of diabetes in pregnant women which I have collected from the literature, shows that in 55 instances the disease was present before the occurrence of the pregnancy in question, while in the remaining 9 it made its first appearance after conception. In this series no case was classified as diabetes unless the characteristic urinary changes persisted after the puerperium, for had the ordinary cases of glycosuria been included it is quite probable that the relationship would have been reversed. At the same time I do not desire to claim that my figures are beyond peradventure, but they at least clearly indicate that diabetes may exist anterior to conception in a much larger proportion of cases than is generally believed.

Upon reviewing the literature upon the subject, it is apparent that diabetes must be regarded as a serious condition no matter whether occurring primarily or as a complication of pregnancy, as is shown by the following figures: Thus, Chapiet, Stengel, Ruoff, and Vinay reported a maternal mortality of 25, 26, 46, and 55 per cent., respectively, in four tabulations which included 68, 19, 28, and 34 cases. My own statistics, which are based upon 66 cases collected from the literature, show an immediate maternal mortality of 27 per cent., while an additional 23 per cent. of the patients died within the following two years.

Generally speaking the patients do comparatively well for the first seven or eight months of pregnancy, although they may suffer considerably from pruritus, increased thirst, ravenous appetite, and frequent micturition. Exceptionally coma may supervene in the latter part of pregnancy, and the patient may die undelivered or shortly after the birth of the child, as reported by Born, Hofmeier, and others; although occasionally, as in the case reported by Offergeld, she may rally from the comatose condition and die weeks or months later. More usually, however, symptoms do not appear until the time of labor, and in such cases the patient may die either in coma or collapse within a few hours after the birth of the child; but even at this time coma is not necessarily fatal, as recovery has been reported and the patients have lived for some time afterward.

On the other hand, in a considerable proportion of cases, labor and the puerperium go on normally, while the diabetes pursues its usual course and leads to death in coma or from tuberculosis months or even years later. Moreover, it is a well-established fact that certain subjects may repeatedly give birth to children with comparative impunity. This occurred in Case VI, and was strikingly exemplified by the experience of Lecorché and Lop. The former reported that uncomplicated pregnancy and labor had occurred in seven of his patients, while the latter stated that four women under his care had gone through 6, 3, 2, and 1 normal labors respectively, after the diagnosis of diabetes had been definitely established.

I have included among the diabetic cases only such patients as died with characteristic symptoms, or in whose urine the presence of glucose was repeatedly demonstrated after childbirth. If this precaution be not taken many cases, which are merely examples of some of the other forms of glycosuria, will be improperly placed in this category. In order to illustrate this point I have included in Section "C" of my table 10 cases which are usually described as diabetic by other writers, but from whose urine all trace of sugar disappeared immediately after delivery. These ten women had twelve children with no maternal mortality and but two foetal deaths, a result which is so striking as to cast grave doubt upon the correctness of the diagnosis.

The deleterious effects of diabetes whether existing before conception or appearing during the course of pregnancy are not limited to the mother, as a review of the literature shows that the child suffers equally severely. Thus abortion and premature labor occur more frequently than usual, and even if the pregnancy goes on to term it is not unusual for the child to die shortly before the onset of labor and to be born in a more or less macerated condition. Moreover it seems that the condition frequently predisposes to excessive development on the part of the child, which may give rise to serious dys-tocia and lead to its death during delivery.

Some idea of the increased danger to the child may be gained from

the tabulations of Chapiet, Duncan, Vinay, Stengel, and Ruoff, according to which the foetal mortality was 27, 47, 48, 50, and 53 per cent. respectively. Chapiet's figures are based upon the largest series of cases: 103 pregnancies occurring in 68 women.

One of the interesting complications associated with the condition is hydramnios, with its serious effect upon the development of the child and its tendency toward the production of premature labor. I have been able to collect from the literature twelve examples of this condition, namely, the cases reported by Duncan, Reid, Husband, Warner, Hehir, Ludwig, Rossa, Lop, Herman, Liepmann, Hofmeier, and Offergeld. Moreover, it is interesting to note that the amniotic fluid frequently contains sugar, its presence having been demonstrated chemically in more than one-half the cases, while in some of the earlier ones its presence was indicated by the sweet taste and sticky consistency of the fluid. In the observations of Ludwig, Rossa, Herman, Hofmeier, and Offergeld quantitative determinations were also made and the amount of sugar was found to vary from 0.165 to 0.7 per cent. The fact that it disappeared from the urine of Rossa's patient shortly after delivery would apparently indicate that it was not a case of true diabetes, and accordingly it may be concluded that sugar may be present in the amniotic fluid in simple glycosuria as well as in diabetes.

Observations of this character are of interest not only in themselves, but also because they at one time seemed adapted to throw some light upon the vexed question of the origin of the amniotic fluid. At first they apparently indicated that it must be a transudate from the maternal blood, as the absence of sugar from the foetal urine in several instances, as well as the fact that several other children were born in a macerated condition, indicated that their urinary secretion could not have contributed to the formation of the amniotic fluid. Unfortunately the observations of Chamberlent and Offergeld have shown that such conclusions are untenable, as the former demonstrated the existence of glycosuria in a child born of a diabetic mother, and the latter showed that both the blood and urine of an unborn child contained glucose, thereby raising the question whether the latter had been transmitted through the placenta or indicated the existence of foetal diabetes.

DIAGNOSIS. From what has already been said it is apparent that the mere reduction of Fehling's solution, upon which the practitioner ordinarily bases the diagnosis of diabetes, is open to many interpretations in the pregnant woman. Leaving out of consideration all substances other than sugar which may give rise to such a reaction, it may be obtained in as radically different conditions as lactosuria, the several varieties of glycosuria, and true diabetes. Accordingly the mere detection of the presence of sugar is of but little diagnostic or prognostic value, and as far as my experience goes has been pro-

ductive of quite as much harm as good, in that it frequently leads the incautious practitioner to diagnosticate the existence of diabetes with its comparatively sombre prognosis in patients who present a harmless lactosuria or glycosuria. That this is the case is shown by the fact that each year I receive letters from physicians in different parts of the country asking for advice in cases of supposed diabetes complicating pregnancy, which upon closer investigation have nearly always proved to be examples of transient glycosuria or lactosuria.

Therefore, whenever the presence of sugar is demonstrated in the urine of a pregnant woman, the first essential is to determine whether it occurs in the form of glucose or lactose. For practical purposes this is readily ascertained by the use of the fermentation saccharometer, as glucose ferments readily while lactose does not. If more accurate information is desired the characteristic glucosazone or lactosazone must be isolated, but unfortunately this latter procedure cannot be employed if quantitative results are desired. Moreover, it should be borne in mind that both glucose and lactose may occur together, and such a combination should be suspected whenever there is a discrepancy between the readings obtained by titration with Fehling's solution and by the use of the saccharometer, or when the polarimeter indicates the presence of a greater amount than the saccharometer.

If the sugar is definitely shown to be lactose, the condition must be regarded as lactosuria and may be dismissed from consideration as of no practical significance. On the other hand, if the presence of glucose is demonstrated the matter is not so simple, as it is then desirable to determine whether the patient is suffering from true diabetes or merely from transient or alimentary glycosuria. Unfortunately such a differentiation is by no means easy and frequently cannot be made without prolonged observation or knowledge of the previous history of the patient. If it be known that the glycosuria existed before conception the diagnosis of diabetes is assured, but if it were first detected during the course of pregnancy the interpretation is not so clear.

Generally speaking it may be said that a tentative diagnosis of diabetes is permissible whenever large amounts of glucose are present, or the patient presents characteristic symptoms; whereas transient or alimentary glycosuria should be suspected if the percentage of sugar is low and symptoms are absent. Such rules, however, are not absolute, as it sometimes happens that in the first class of cases the sugar and symptoms may permanently disappear after the delivery, while in the second the glycosuria may persist after labor and the characteristic symptoms of diabetes sooner or later may become manifest. This was clearly shown in Case VI, which was considered as transient glycosuria during pregnancy, and yet was shown to be true diabetes by the subsequent course of events.

Likewise the persistence or disappearance of sugar under dietetic treatment does not necessarily afford accurate information concerning the nature of the condition, as it sometimes happens, on the one hand, that cases of glycosuria will be uninfluenced by a carbohydrate-free diet, while, on the other hand, in true diabetes all trace of sugar may disappear temporarily under a plain milk diet, as was demonstrated in Cases II and III and Case VI, respectively.

The existence of alimentary glycosuria should be suspected in any case in which the sugar disappears from the urine upon the removal from the diet of certain saccharine substances, but without restricting the use of other carbohydrates. In view, however, of what has been said concerning the common factors in the etiology of transient glycosuria, it is manifest that it frequently will be impossible to differentiate between the two conditions.

PROGNOSIS AND TREATMENT. Unless the condition can be demonstrated to be either lactosuria or definite alimentary glycosuria, the presence of sugar in the urine of a pregnant woman should be regarded as a danger signal, and as an indication for continuous and careful observation. If diabetes be definitely diagnosed from the previous history of the patient, the condition should be regarded as serious but by no means hopeless for either the mother or child, for as long as the patient presents no serious symptoms, acetone bodies are absent, and the output of sugar can be controlled by dietetic means, the prognosis may be regarded as favorable as far as the present pregnancy is concerned, and all that is necessary will be careful supervision. If, however, serious symptoms supervene, acetone bodies appear in the urine, or the output of sugar cannot be controlled by dietetic means, the condition should be considered as alarming and the pregnancy should be ended at once by the most appropriate means, as its continuance will add to the danger of the mother, while the child's prospects are so poor that they are not entitled to consideration. It is of course understood that the interruption of pregnancy will not cure the underlying disease, but it may nevertheless temporarily relieve the disordered metabolism from such a degree of strain as to enable nature to reassert herself and thus allow the patient to live for several years.

Most writers upon the subject advocate the induction of premature labor under the conditions just mentioned, although Vinay and Kleinwächter are absolutely opposed to it, while Graefe and Lesse believe that it is indicated only when the diabetes is complicated by hydramnios. Fellner, Schauta, and Senator and Kamminer hold that abortion is indicated in the early months provided the diagnosis is assured. Likewise the same line of treatment is indicated even if the existence of diabetes is not absolutely certain, but is rendered probable by the presence of large amounts of sugar or by the onset of threatening symptoms.

TABULATION OF CASES OF DIABETES COMPLICATING PREGNANCY.
A. *Pregnancy Occurring in Diabetic Patients.*

Author.	Date.	Age.	Para.	First symptoms.	Per cent. of sugar.	Pregnancy.	Labor.	Complications.	Child.	Mother.
1. Husband . . .	1874	26	III	Uncertain.	5.5	?	Spontaneous.	None.	Very small, lived several days.	Died 8 months later from tuberculosis.
2. Newman (a) . .	1876	36	II	Several years.	4.0	Uneventful.	"	"	Normal.	Diabetes continued.
3. Newman (b) . .	1876	36	III	Same patient as case (a).	4.0	"	Premature, sixth month.	"	Dead.	Died in coma third day.
4. Newman (a) . .	1878	32	m.p.	? (a).	?	"	Spontaneous.	"	Normal.	Diabetes continued.
5. Newman (b) . .	1880	34	m.p.	Same patient as case (a).	?	"	"	"	"	Died in coma 2 years later.
6. Duncan . . .	1879	35	XI	Previous pregnancy.	Large.	Great thirst.	"	"	"	Died comatose 8 months later.
7. Reid . . .	1880	32	II	Several years.	10.0	Thirst and diuresis	"	Hydramnios, fluid sticky.	Large, macerated.	Typical diabetes 2 years later.
8. Williams (a) . .	1880	?	I	? (a).	?	Uneventful.	"	None.	Normal.	Sugar afterward.
9. Williams (b) . .	1881	?	II	Same patient as case (a).	2.0	"	"	Hydramnios, no sugar.	"	Diabetes continued.
10. Williams (c) . .	1881	?	III	Same patient as cases (a) and (b).	5.0	"	"	None.	"	Died 6 weeks later in coma.
11. Williams . . .	1882	36	VI	Uncertain.	Large am't	Thirst and diuresis	"	"	Macerated.	Died in coma 4 months later.
12. Duncan . . .	1882	30	V	Several years.	3.0	Uneventful.	Low forceps.	.....	"	Died third day after delivery in collapse.
13. Lecorché (a) . .	1885	?	?	Before pregnancy.	?	"	Spontaneous.	.....	Normal.	Diabetes continued.
14. Lecorché (b) . .	1885	?	?	"	?	"	"	.....	"	"
15. Lecorché (c) . .	1885	?	?	"	?	"	"	.....	"	"
16. Lecorché (d) . .	1885	?	?	"	?	"	"	.....	"	"
17. Lecorché (e) . .	1885	?	?	"	?	"	"	.....	"	"
18. Lecorché . . .	1885	?	?	"	?	"	"	Premature rupture membranes Eighth month.	Died second day.	"
19. Lecorché . . .	1885	?	?	"	Slight.	"	Premature.	.....	"	"
20. Tarnier and Budin	1886	?	?	"	5.0	None.	Spontaneous.	None.	"	"
21. Tarnier and Budin	1886	?	?	"	"	"	Premature at six months.	.....	Dead.	Died in coma 3 hours later.
22. Warner (a) . . .	1886	32	II	Second pregnancy	Definite.	Symptoms.	Spontaneous.	None.	Large, macerated.	Diabetes persists.
23. Warner (b) . . .	1886	?	III	"	"	"	"	Hydramnios.	"	"
24. Warner (c) . . .	1886	?	IV	"	"	"	"	None.	"	"
25. Warner (d) . . .	1886	?	V	"	"	"	"	.....	"	"
26. Packard . . .	1889	41	m.p.	For years.	4.06	"	Repeated abortions.	.....	Abortion.	"

B. Diabetes Developing during Pregnancy.

Author.	Date.	Age.	Para.	First symptoms.	Per cent. of sugar.	Pregnancy.	Labor.	Complications.	Child.	Mother.
58. Duncan . . .	1871	30	III	Early in pregnancy.	Large.	Emaciation, anasarca.	Accouchment force.	.....	Macerated.	Died in coma third day
59. Winckel . . .	1874	?	?	Day of labor.	"	Normal.	Slow.	Hydramnios.	Normal.	Sugar on discharge thirteenth day.
60. Loeb . . .	1881	22	?	Second month.	4.0	Symptoms.	Abortion at six months.	.....	Dead.	Died 1 month later.
61. Davidson . . .	1882	38	IV	Middle of pregnancy.	10.0	Thirst, emaciation	Spontaneous, premature.	None.	Died 13 hours.	Died in coma 4 months later.
62. Frierichs . . .	1882	36	X	Eighth month.	?	Normal.	Normal.	"	Normal.	Death 15 months later, phthisis, brain tumor.
63. Fry . . .	1891	31	II	Fourth month.	3.0 to 6.0	Symptoms.	Premature.	"	Macerated.	Died in coma 3 days later
64. Born . . .	1892	24	I	Seventh month.	8.5	"	Died in coma undelivered at seven months.	.....	Dead.	Died in coma.
65. Taylor . . .	1897	31	II	Sixth month.	8.5	No symptoms.	Normal.	None.	Normal.	Diabetes persists.
66. Herman . . .	1902	30	VII	Third month.	2.0 to 3.0	Comatose.	Premature.	Hydramnios.	Macerated.	Died ninth day, sarcoma of lung.

9 pregnancies in 9 women: 78% maternal mortality; 45% in first ten days; 33% one to fifteen months later; 66.67% fetal mortality.

C. Doubtful Cases of Diabetes Complicating Pregnancy. Sugar Disappeared after Delivery.

Author.	Date.	Age.	Para.	First symptoms.	Per cent. of sugar.	Pregnancy.	Labor.	Complications.	Child.	Mother.
67. Bennewitz (a)	1826	22	IV	This pregnancy.	?	Intense thirst.	Spontaneous.	None.	Normal.	Sugar disappeared.
68. Bennewitz (b)	1826	?	V	Early.	12.0	"	Operation.	Threatened coma.	Dead, 12 lbs.	Perfect recovery.
69. Bennewitz (c)	1826	?	II	"	?	"	Spontaneous.	None.	Normal.	"
70. Williams	1882	33	VII	"	Considerable	Emaciation.	Forceps.	Perineal tear.	"	"
71. Marcus	1892	27	I	Puerperium.	0.7	None.	Forceps.	Decubitus.	"	Sugar disappeared 5
72. Trouillard	1893	28	III	Early in pregnancy.	?	Thirst, semioleone	Abortion.	Twins at five months.	Dead.	months later.
73. Partridge	1895	20	I	Fourth month.	3.0	Marked symptoms	Spontaneous.	Albuminuria.	Normal.	No sugar for next 2 years.
74. Taylor	1897	39	m.p.	Seventh month.	0.75	No symptoms.	"	None.	"	No sugar after labor.
75. Rouff (a)	1903	25	II	This pregnancy.	4.0	Pruritis.	Version.	Hydramnios.	Lived 12 hours.	Gradually disappeared.
76. Rouff (b)	1903	25	IV	Fourth month.	?	Slight symptoms.	Forceps.	"	Dead.	Disappeared after delivery.
77. Rouff (c)	1903	25	V	Onset of pregnancy.	5.0 to 7.0	Marked symptoms	Induced labor at eight months.	"	Lived 3 months.	Disappeared permanently
78. Stengel	1904	33	II	Sixth month.	5.0	Hunger and thirst	Spontaneous.	None.	Normal.	"
79. Dureau	1905	37	III	Seventh month.	Large amt	Intense thirst.	"	Rigorous diet.	"	"
80. Tate (a)	1906	33	II	Third month.	Considerable	Pruritis, thirst.	Abortion at four months.	"	Dead.	Disappeared 4 weeks later.
81. Tate (b)	1906	35	III	Second pregnancy.	Present.	"	Spontaneous.	None.	Normal.	Disappeared later.

15 pregnancies in 10 women; no maternal deaths; 12 labors at term; 1 premature labor; 2 abortions; 10 live children (75 per cent.).

On the other hand, it should be remembered that in the vast majority of cases the presence of sugar is not indicative of the existence of diabetes, but merely of transient or alimentary glycosuria, and the latter diagnosis should be made tentatively whenever the amount of glucose does not exceed 2 or 3 per cent. and symptoms are absent or only slightly marked. In such cases the urine should be examined at frequent intervals and the amount of sugar excreted in the twenty-four hours definitely determined. As long as it remains stationary or can be controlled by dietetic measures, the prognosis should be regarded as favorable and there should be no thought of interfering with the pregnancy.

In view of the fact that many cases of mild diabetes have no deleterious effect upon the course of pregnancy and labor, such an outcome should not be taken to indicate that the condition is merely simple glycosuria; but the urine should be examined at varying intervals following delivery and diabetes should be diagnosticated if sugar is persistently present, whereas if repeated examinations show that it has disappeared, such a diagnosis is not justified no matter what its percentage may have been during pregnancy or by what symptoms it may have been accompanied.

CONCLUSIONS. 1. A positive reaction with Fehling's solution during pregnancy does not necessarily indicate the existence of diabetes, but is usually due to lactosuria or to transient, alimentary, or recurrent glycosuria.

2. In such cases it is imperative to determine whether the sugar occurs as lactose or glucose, as lactosuria is without clinical significance and is probably associated with premature activity of the breasts.

3. The significance of glycosuria is not so clear. If alimentary in character it may be regarded with impunity. Otherwise it may be of the transient or recurrent variety, or may indicate the existence of true diabetes.

4. If the glycosuria appears late in pregnancy, does not exceed 2 per cent. in amount and is not accompanied by symptoms, it is probably transient and may disappear spontaneously at any time or persist until the end of pregnancy. In either event it is usually of slight clinical significance, and merely indicates that the patient should be carefully watched.

5. If the sugar appears early in pregnancy and in large amounts the condition is more serious, as it may be impossible to make a positive diagnosis until after delivery, when the condition disappears in glycosuric but persists in diabetic cases.

6. Pregnancy may occur in diabetic women or diabetes may become manifest during pregnancy. Either is a serious complication, although the prognosis is not so alarming as is frequently stated; many patients do perfectly well, while a smaller proportion die in coma or collapse at the end of pregnancy, or during or shortly after labor.

7. If the output of sugar is large and cannot be controlled, or at least markedly diminished by suitable dietetic and medicinal treatment, the induction of abortion or premature labor is indicated even in the absence of serious symptoms, and much more so when they are present.

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MEDICAL GYMNASTICS IN EARLY MYOCARDIAL INCOMPETENCE WITHOUT VALVULAR DISEASE.

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THERE is a large and important group of cardiopathies which is encountered among business men, and which furnishes such a great contingent to the increasing number of deaths from heart disease as to call for preventive and therapeutic measures. The cases referred to are found especially among men of affairs who, in response to the demands of modern commercial methods, lead very strenuous lives. The high tension under which professional and business men work nowadays is, of course, not the only, nor perhaps the chief, factor in producing myocardial incompetence, but it contributes powerfully to this end, no doubt. We may never be able to discover the cause or causes in more than a general way, as at present, and, moreover, we must not ignore the role played by acute and chronic infections in the etiology of cardiovascular degenerations, but in studying the class of cases that form the subject of this paper, with a view to therapy as well as etiology, it will be well to bear in mind the teachings of pathology.

The cardiopaths now considered are generally men of large physique, who, in addition to an occupation necessitating many hours daily at the office desk or in the counting room, are generous livers and often heavy smokers. Accordingly they take on weight, and very commonly display an abdominal girth out of proportion to their chest measurements. In a proportion of the cases these men, endowed with a magnificent physique, have been athletes in college, but on entering professional or commercial life have neglected physical exercise because of the ardor with which they devote their energies to their chosen careers. In the majority of instances these individuals possess indomitable energy and almost tireless activity, and display a systolic blood pressure that is well up toward, if not actually above, normal limits. Such, in the main, are the physical makeup and business conditions of these men who, in the late fifties or early sixties, consult us for symptoms which betoken long-endured and at length injurious cardiac strain.

Regarding the pathology of these cases, it need only be pointed out that the whole cardiovascular system is a sufferer, though not uniformly. The kidneys, too, participate in this degenerative process, but in the cases especially referred to in this paper, renal inadequacy is not marked and is overshadowed by that of the heart. The coronaries do not escape, but only occasionally are so involved as to occasion the symptoms of angina pectoris. The heart muscle

is the portion of the circulatory apparatus which first forces its functional disturbance upon the notice of the individual. Yet it has not been the first to feel the injurious effects of those various factors that are bound, in time, to bring disaster, for, as Hasenfeld and others have shown, the degenerative process begins in the intra-abdominal vessels, which are under the immediate control of the splanchnic nerves. There is persistent increase of blood pressure within this area, and, secondarily, throughout the entire vascular system. Strain on the myocardium results, and this enormous peripheral resistance, augmented by the strenuous and luxurious conditions of modern city life, wear out the heart prematurely.

Whatever may be all the factors or the precise *modus operandi*, I was impressed years ago by the clinical observation pointed out by Fraentsel in his classic description of what he termed idiopathic enlargement of the heart, namely, the frequency of myocardial incompetence in men of impressive abdominal girth and large physique, who spend their business hours in their office chairs and take altogether too little exercise in proportion to their consumption of food.

Therefore, in reflecting upon these various considerations, pathological and etiological, I came to the very natural conclusion that if the heart were to be strengthened, it would have to be relieved of some of its load, and not merely whipped on by digitalis. In other words, the peripheral resistance existing in the sluggish circulation within the mesenteric vessels should be lessened. That is, since these individuals sit too long, and their hearts are deprived of the aid that comes from muscular exercise and deepened respiration, they should endeavor to counteract this injurious tendency.

The foregoing reflections led me to the belief several years ago that in the early stage of myocardial incompetence the rational therapy lay in such means as was most likely to counteract the primary circulatory condition conceived to underlie the cardiac hypertrophy. Accordingly I began to send men of the type described to a medical gymnast, to whom was explained the end to be attained. He comprehended my purpose, and, being familiar with the investigations of Levin, subjected the patients to a course of gymnastics of the kind studied by Levin. This investigator showed, by a record of 600 pulse readings, that if certain simple exercises were given properly, they were capable of *slowing* and *strengthening* the pulse, instead of accelerating it, a *very vital principle* in the class of cases here considered.

The medical gymnastics consist of both active and passive movements, according to the degree of myocardial incompetence present. The former comprise certain rolling and bending movements of the trunk executed by the gymnast, who, standing behind the individual seated on a wooden horse, with his feet held firmly by toe-straps,

grasps the shoulders and firmly yet not too vigorously bends the body forward and then rolls it around to the opposite side in a backward direction, in such a manner that, flexed in the beginning, the trunk becomes extended when the movement is half completed, and ends again in a position of strong flexion. To these may be added passive flexion and extension of the extremitities, and alternate expansion and compression of the chest, very much after the manner of performing artificial respiration.

The active exercises, which in all cases are gentle at first, and performed by the help of the gymnast, and only by degrees increase in vigor, consist in deep breathing, in bending, pulling, lifting, etc., on a horizontal bar or ladder, or such other movements as in the judgment of the gymnast will promote respiration and venous flow and reduce the girth of the abdomen.

But whatever be the kind of exercises, one essential principle underlies them all, namely, *the patient must not be allowed to hold his breath, but must breathe regularly and deeply in rhythm with the movements*, so as to inspire or expire according as the exercises expand or contract the chest, and depress or raise the diaphragm. It is this rhythmical breathing which the gymnast must watch carefully, for it is found that so soon as the individual holds his breath his face becomes congested and his pulse accelerated; whereas, if respiration is carried on regularly, the opposite effect is produced. Lastly, the gymnast keeps close watch of the pulse, and whenever it is observed to show acceleration and diminished volume the individual is made to rest or to breathe deeply in such a manner as will improve pulse rate and volume.

The purpose of these exercises is not the development of the skeletal muscles, but the restoration of the functional integrity of the myocardium, and this they accomplish more or less effectively, not only by increasing venous flow on the one side, and by dilating the intermuscular arterioles on the other, but also by improving cardiac metabolism. This last is the result of several factors. In the first place, the circulation within the coronary vessels is improved, for with more efficient systoles the coronary veins are more fully emptied and the heart muscle receives a greater supply of arterial blood. This direct effect upon coronary circulation is enhanced by the improved flow in the pulmonary vessels, and consequently a better oxygenation of the blood supplied to the myocardium, while the correction of a tendency to stasis within the right auricle removes any impediment to outflow from the coronary veins and lymphatics into the auricle occasioned by overfilling of its cavity. From whatever standpoint, therefore, we contemplate the effect of these gymnastics, we see they must be theoretically, if not practically, beneficial.

This brings us to the query: Do the results bear out the theory, and how great and how lasting is the improvement? It is not

practical to report cases in response to this query, and hence it must suffice if the subjective and objective effects are stated.

Of course, the degree and permanence of the improvement must depend largely upon the state of the heart muscle. If this is extensively degenerated, no amount or kind of treatment can be expected to achieve much, and such improvement as is gained cannot last long. In such cases, therefore, if dilatation and inadequacy are pronounced, the so-called resistance exercises are preferable, although to these may be added with advantage such deep breathing movements as, with the aid of a trained attendant, can be performed without danger of strain to the heart wall.

As might be expected, the most pronounced benefit has been observed in cases of early or moderate myocardial incompetence, shown by breathlessness or palpitation upon slight cause, and upon examination by increased cardiac dulness, feebleness of the first tone at the apex, accentuation of the pulmonic second sound, and sometimes a faint systolic whiff in the mitral area. In most, but not all, cases the blood pressure is elevated above the normal. In such cases the first indication of improvement is shown by greater ease of respiration and a general sense of ease or lightness. Energy is increased and fatigue comes less easily, while a better action of the bowels and a diminution of waist measure are quite generally observed. These subjective indications of improvement have been especially and repeatedly marked in a man, aged fifty-nine years, with stiff arteries, a systolic blood pressure of 225 (broad arm band), and a greatly hypertrophied, habitually accelerated heart. After a month's treatment he is generally quite ready to cease the exercises, because satisfied with the improvement. Indeed, one of the difficulties met with has been the convincing of the patients of the wisdom of a continuance of the treatment with a view to preventing the return of the symptoms.

Objectively, it is noted at the time of the exercises that the pulse slows and its quality improves, provided the movements are properly directed by the assistant, and the breathing is carried on regularly, as already stated. Consequently it is of the utmost importance that these exercises be controlled by a trained assistant, and that the individual be forbidden the performance of so-called self-resisting exercises at his home.

The effect is thus seen to be quite different from that of ordinary physical exertion, which, when the myocardium is damaged, causes acceleration of the heart's action without subsequent rise of blood pressure as the heart resumes its wonted rate. This lack of recovery (Graupner's *Erholung*) is a sign of cardiac weakness, and in the class of cases here considered it is not desirable to have the myocardium subjected to such a degree of strain. Accordingly, it is important that these medical gymnastics be given by an assistant who understands the kind of exercises which slow and strengthen the

pulse, and will maintain a careful watch over the pulse and color of the skin, in order to detect the earliest signs of cardiac strain.

To make matters doubly sure, it is my wont to examine the patients directly after the first one or two sances, and thereafter once a week.

If the myocardium is susceptible of improvement, this is shown by decrease in the area of dulness, especially on the right, added strength and clearness of the heart tones, and often by the disappearance of the systolic whiff of muscular mitral incompetence previously heard at the apex. Almost without exception the results observed have been gratifying, and have justified the recommendation of this plan of therapy.

In some cases there has been a small amount of medication, either in way of preparation for this gymnastic treatment, or to assist in more speedily and surely restoring cardiac efficiency. The medicinal therapy has consisted in occasional cathartics, a vasodilator, as nitrite of sodium, strophanthin, digitalin, etc., but in all truth it may be said that the medical gymnastics have been the main agent in the accomplishment of the results noted. Indeed, so much pleased have I been that I seldom nowadays prescribe the so-called resistance exercises of Schott, because, even when the heart may be too feeble to endure anything more than deep breathing in the manner described, this seems to me fully as efficient, in conjunction with other measures, as are the Schott movements.

In conclusion, my experience with medical gymnastics in cases showing early incompetence of the myocardium warrants me in recommending them, if properly controlled, and in asserting the belief that, if these and allied physical exercises were used more extensively and systematically by men of the build and habits to develop chronic myocardial and arterial disease, they would delay, if not prevent, the onset of cardiac inadequacy.

THE VALUE OF THE INUNCTION METHOD OF ADMINISTERING DRUGS TO CHILDREN.

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IN 1894¹ and in 1901² I published papers on the value of inunctions of guaiacol in the treatment of tuberculosis in infants and children. Since my first publication on this subject, fourteen years

¹ Ohio Med. Jour., May, 1894.

² Archives of Pediatrics, May, 1901.

ago, I have continued to use this treatment daily in hospital and private practice, and my long experience with it has confirmed my earlier views that guaiacol, when administered in this way, is the most valuable medical remedy we have in the treatment of this disease.

My experience with inunctions of guaiacol during these years has increased my interest in this method of administering drugs to young children, and has led me gradually to the belief that a number of other drugs may be more advantageously administered by inunction than by the mouth, and that especially in young children a number of diseases, such as hereditary syphilis, infantile tuberculosis, and respiratory diseases, such as bronchitis and pneumonia, can in most instances be more readily influenced by medicines given by inunction than they can be by medicines given by the mouth, even if the latter mode of administration did not disturb the functions of the gastro-intestinal tract. Cushny says: "The great mass of drugs absorbed from the stomach and intestines is carried to the liver before reaching the general circulation, and this is of great importance in determining their effects in the body, as some of them are retained in that organ, and are either entirely destroyed or escape so slowly that they have no perceptible effect." This objection does not apply to drugs that are given by inunction, since the liver is not interposed between their point of absorption and the lymphatic and general circulation.

It is apparent, therefore, that all drugs which favorably influence lymphatic disease and which can be introduced by inunction will be much more efficacious when given in this way; and it is also apparent, especially in young children, that all drugs which can be administered by inunction, and which are intended to influence favorably diseased processes in the blood, in the respiratory passages, or at the point of excretion of the various drugs, should preferably be administered in this manner rather than by the mouth.

These views prompted me to make certain experiments bearing upon the absorption of medicines given by inunction, and have led me to the presentation of this paper, which deals specifically with this form of administering certain drugs for the purpose of combating certain diseases in infants and young children.

Inunctions are very much more efficacious for the treatment of disease in young children than they are in adults, for the following reasons:

1. In infants the surface of the skin in proportion to the body weight is four times greater than it is in adults. This brings the whole blood and lymph circulation of the infant in close communication with the bloodvessels and lymphatics of the skin and makes it possible for drugs which are rubbed into the skin to pass quickly through the body and make their appearance in the urine, feces, bronchial mucus, and other excretions.

2. In infants the vasomotor mechanism is much more responsive to reflex stimuli than it is in adults, and for this reason the capillary circulation in the skin of the infant is made much more active by the application of heat and friction, as in the giving of inunctions. This facilitates the absorption of the inunction and the ready introduction of medicines into the general circulation.

3. All lymphatic structures are functionally more active in the young child than in the adult, and the lymphatic circulation in the skin and in other parts of the body is relatively more active and functionally more important than it is in the adult. This facilitates the absorption of inunctions and makes possible the ready introduction of medicines through the skin into the lymphatic circulation.

4. In young children, and especially in infants, the nutritional problems in the treatment of all diseases are of vastly greater importance than they are in the adult, and it is, therefore, of the utmost importance that the stomach and intestinal canal should be kept in the best possible condition; consequently all drugs that can be advantageously administered in some other manner should be kept out of the stomach. This is especially true of drugs that are intended to influence general metabolism and to act upon diseased tissues remote from the gastro-intestinal canal.

5. The diseases which can be reached most readily by inunctions, such as diseases of lymphatic structures and of the respiratory passages, are much more common and much more severe in young children than they are in adults, which facts very much enhance the relative importance of the inunction treatment in young children.

6. Experiments demonstrate that certain medicines may be introduced with great facility, by inunctions through the skin, into the circulating media of the body, and that this result is more readily accomplished in infants and young children than it is in adults.

In my experiments I used guaiacol, iodine, oil of wintergreen, and salicylic acid. These medicines, with the exception of the iodine, were combined with anhydrous lanolin in the proportion of one dram to the ounce. The iodine used was a 6 per cent. iodine-vasogen. In adults stronger ointments, two drams to the ounce, were employed.

In applying the ointments the following technique was observed: The skin of the chest and abdomen was carefully washed with soap and warm water, and hot, moist towels were then applied for a few moments to warm and redden the skin. One dram of the ointment was then very carefully and gently rubbed into the skin of the chest and upper part of the abdomen. The inunction was continued for from five to ten minutes. Previous to the inunction the child's bladder had been emptied, and directions were then given to save all urine passed. If at the end of two hours no urine was obtained the bladder was emptied by catheterization, and subsequent specimens of urine were also saved for examination. The urine thus

obtained was examined to determine the presence or absence of the drug which had been administered by inunction.

By this method the following results were obtained: Eight children under seven years of age were rubbed with oil of wintergreen, and in every instance the drug was found in the urine within two hours after rubbing. It was observed that in the younger children, some of whom were less than a year of age, the reaction in the urine occurred earlier, in one instance within an hour and one-half, so that, on the whole, it may be said that the younger the child the earlier the reaction; if a definite time limit was observed the reaction was stronger in the younger children.

The reaction could also be obtained in the adult by using twice or three times the quantity of oil of wintergreen and applying the inunction for a longer time. This was true also in the inunction experiments with the other drugs, so that I think it may be definitely stated that the urinary reaction showing the presence of the drug could always be obtained in the adult if a larger dosage and longer and more vigorous rubbing were resorted to, but even under these conditions the reaction in the adult urine was not as pronounced as it was in the infant.

As an example let me cite the following experiment: R. S., aged four years, weight $28\frac{1}{2}$ pounds. Oil of wintergreen inunction at 1 p.m. One dram of the ointment used; the inunction lasted five minutes. At 3 p.m. the urine showed rather faint traces of the drug; at 5 p.m. the reaction was much more marked; at 10.30 p.m. it was very well marked, and a second inunction was given at this time. At 1 a.m. the reaction was much more intense. This experiment shows the gradual increased elimination of the drug for five or six hours after the inunction, and also that under repeated inunctions the reaction becomes more and more intense.

Salicylic acid was used by inunction in five children under nine years of age, in all of whom the drug was found in the urine within three hours after the inunctions. It was thought that the reaction from salicylic acid appeared in the urine almost if not quite as readily as it did from the oil of wintergreen. Salicylic acid was also found in the urine of two adults who were rubbed with larger quantities for a longer time.

Guaiacol was used by inunction in 14 children and 8 adults. In all the children positive reactions were obtained in the urines within two hours. In two of the younger ones the reaction was obtained within an hour and one-half. In 4 of the adults a negative reaction was obtained after two, three, and four hours, but in these only one dram of the guaiacol ointment was used. In the other 4 adults two or three drams of the ointment were used and the inunction was applied for a longer time. In all of these a positive reaction was obtained within three and one-half hours.

Iodine was used by inunction in 6 children and 3 adults, in all of

whom a positive reaction in the urine was obtained within two hours. With the children one dram of the iodine-vasogen was used, and the inunction was applied for from five to eight minutes. In the adults two or three drams was used and the inunction was applied for ten or fifteen minutes.

These experiments demonstrate the practicability of administering by inunction to infants and young children guaiacol, salicylic acid, oil of wintergreen, and iodine, and they also show that this method of administering medicines is probably more efficacious in children than it is in adults.

Oils by Inunction. Almost from the beginning of the history of medicine the general profession as well as the laity has had great faith in the restorative power of inunctions of oil. And at the present time our faith in oil inunctions is almost as great as at any other period in the history of medicine. This faith, founded on empiricism and supported by countless clinical observations, is perhaps as firmly grounded as most of our ideas concerning the medical treatment of disease. There can be little doubt that lanolin, lard, codliver oil, and other fats may be introduced by inunction through the skin of the infant in sufficient quantities to aid materially the nutritional processes. This method of administering fats is of real value in very young children suffering from chronic nutritional disturbances, whose gastro-intestinal canal forbids the administration of fats by this channel in sufficient quantities to supply nutritional demands.

Guaiacol mixed with anhydrous lanolin in the proportion of one dram to the ounce, when administered to young children, as noted in the above experiments, quickly enters the lymphatic and general circulation and, compassing every part of the body, passes to the beginning of its excretion in the urine within two hours. This fact makes guaiacol, administered in this manner, a valuable remedy in certain diseases: (1) When a general or local lymphatic antiseptic is indicated, as in lymphatic tuberculosis and tubercular peritonitis; (2) in streptococcic and other localized infections of lymphatic tissues, as in non-tuberculous enlargements of the lymphatics of the neck and other parts of the body; (3) in pulmonary tuberculosis and in all diseases in which a pulmonary and bronchial antiseptic is indicated, as in the various forms of bronchitis, pneumonia, and other diseases of the respiratory tract in infants.

For many years I have followed the plan of treating influenza, bronchitis, and all the milder affections of the respiratory tract in infants with guaiacol inunctions to the exclusion of almost every other form of medication intended to influence by internal administration local conditions in the lungs or bronchial tubes. In other words guaiacol has taken the place of all expectorants, including the ammonia preparations, squills, ipecac, and other drugs of this class,

and even in the treatment of bronchopneumonia and lobar pneumonia in the infant guaiacol inunctions have formed an important part of the routine treatment.

I have long been convinced that the routine treatment of bronchial and pulmonary infections in infants, as outlined by our best authorities, which includes the use of such medicines as ammonia, squills, and ipecac, is responsible for no small part of the mortality in these diseases. The substitution, therefore, of guaiacol by inunction for expectorants which destroy the appetite and digestion of young children is of the greatest possible importance as a life-saving measure in the treatment of all bronchopulmonary diseases. It follows, of course, without saying that other rational lines of medication and measures of treatment now in vogue and which do not disturb the stomach are to be continued in connection with the guaiacol treatment of these diseases.

I am prepared to assert that guaiacol given in this way over a long period of time can do no harm. I am sure that I have prescribed it more than a thousand times in the last fifteen years, and I have never seen any ill effects from its use. I have given it in the above dosage to frail and malnourished infants for months at a time, and have seen only good result from its long-continued use.

Iodine by inunction is a rapid and efficacious way of administering iodine to infants and young children for all those conditions in which iodine or the iodides are indicated. This method of administering iodine is especially valuable, since it is almost impossible to give it or any of its combinations to infants by the mouth without producing more harm by upsetting the stomach and interfering with the digestive processes than the possible good which may result from its administration by the mouth. Iodine administered by inunction is of positive value in the treatment of late syphilis, of chronic glandular enlargements, of some acute catarrhal conditions of the bronchial mucous membranes, and as a general alterative in certain forms of chronic malnutrition.

Oil of wintergreen by inunction is a valuable way of introducing this drug into the general circulation in infants and young children. The indications for its use are to be found in all those conditions in which it is necessary to give the salicylates for their influence upon diseased conditions outside of the intestinal canal. In lumbago, acute and chronic rheumatism, chorea, tonsillitis, and endocarditis the salicylates are valuable, and in these and other conditions in which the salicylates are indicated, as good or better therapeutic results can be obtained in infants by inunction of the oil of wintergreen as by giving the salicylates internally. It is evident that by this method the child will be saved from the gastro-intestinal disturbances and consequent interference with nutrition, which so commonly follow the administration of this drug by the mouth. If it be preferred, salicylic acid combined with anhydrous lanolin may

be administered by inunction instead of the oil of wintergreen, as it is absorbed almost as readily.

Mercury by Inunction. This method of giving mercury to infants and young children in the treatment of syphilis is so fully recognized by the profession as being superior to any other method of administration that I do not feel called upon here to more than mention the fact.

Colloidal silver within the past few years has been administered hyperdermically, by the stomach, and by inunction in the treatment of various forms of localized and general septicemia. The profession, as a whole, I think, has come to recognize that this is a most valuable adjunct in our treatment of septicemia, and I for one, after a large experience extending over quite a number of years, am firmly convinced of its efficacy. In the acute enlargement of the lymphatic tissues of the neck which may follow scarlatinal, diphtheritic, and other forms of tonsillitis I believe that this remedy, in the form of unguentum Credé, properly rubbed into the surrounding lymphatic tissues, is of very great value in preventing the spread of the disease and in controlling the localized sepsis. This drug can be given more efficaciously to infants and young children by inunction than in any other manner, and its value in combating general and localized sepsis is of much more value in infants and children than it is in adults, because inunctions in general, are, for the reasons given in the early part of this paper, more efficacious in children than they are in adults.

THE TREATMENT OF IRREDUCIBLE CONGENITAL LUXATIONS OF THE HIP BY OPERATIVE MEANS.

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THE treatment of congenital luxations of the hip by the bloodless method of reduction has so occupied the attention of the profession for many years past, that it may be well to recall what can be done for the relief of those cases which have passed beyond the period when it is possible to reduce the luxation by non-operative procedures. Many such patients pass their earlier years with comparatively little pain, and, notwithstanding their deformity and more or less disability, do not apply for treatment until pain and difficulty of locomotion demand relief. The histories of several cases are briefly as follows:

CASE I.—Jessie V., aged fifteen years, was admitted to the Orthopedic Hospital, October, 1904, with double congenital luxa-

tion of the hips. While both hips were out only the left one was causing complaint. The right one seemed firmly applied to the ilium and did not appear to move in walking. The left one, however, shifted its position markedly. It was quite loose and the left limb was 3 cm. shorter than the right. There was a marked waddling gait and pain which caused her to apply for relief. She was put to bed and weights amounting to fifteen pounds applied for about six weeks. In December, 1904, she was etherized and an unsuccessful attempt was made at reduction by the ordinary circumduction method. Hyperextension over König's padded block was also tried without result. A heavy, wide, close-fitting belt of webbing with a pad and perineal straps was then applied; this afforded some relief and she left the hospital.

In February, 1906, two years later, she was re-admitted with her condition much aggravated. Pain was almost constant, walking for any distance was impossible, and she was unable to earn her living. Her charitable friends were then looking around for some place where she could be taken care of. She was again put on extension and again an unsuccessful attempt was made at reduction. This failing, in April, 1906, she was operated on. An anterior incision was made, a new socket was excavated from the ilium above the old acetabulum, the head of the femur was inserted therein, and the limb was put up in plaster-of-Paris in an abducted position. She was kept abed for eight weeks and then allowed to get up with a cast on. This was removed one month later and in another month she was walking well with the aid of a cane. She was then discharged. Since that time she has improved. While she still has a somewhat peculiar gait she can walk long distances without pain. The hip is movable in all directions, but does not slide up and down; it has evidently retained its position in its new acetabulum. She was formerly unable to take exercise and grew fat and very heavy; now she is active, working, and earning her living, and has lost the excessive fat and weight which previously encumbered her. The transition from her previous helpless condition to her present active and useful one has been very marked.

CASE II.—Minnie II., aged sixteen years, was under treatment in 1892 by another surgeon for some deformity of the feet, the exact character of which is not known. It was stated by the nurse that when an infant the child had paralysis of both lower extremities. Tenotomy of both Achilles tendons was done and later braces were applied and worn continuously thereafter.

In 1897 she came under my care. At that time there was marked paralysis of both lower extremities together with double congenital luxations of the hip. Locomotion was almost impossible. One foot was in marked paralytic valgus, while the other was more of a paralytic equino varus. The left hip was luxated anteriorly, while the right was luxated posteriorly. An arthrodesis was done

on the right foot, which improved its position somewhat. The right hip was then operated on by an incision over the trochanter; the ligamentum teres was removed and the adductors and tensor fasciæ femoris divided subcutaneously. The head was brought down to the acetabulum, but as it would not stay in place a new acetabulum was excavated. The child was markedly strumous and long-continued suppuration followed this operation. It did not involve the deep parts around the bones but rather the superficial parts, so that while very extensive scarring resulted the hip region was not at all stiffened and movements were not restricted. After two months, however, she got up with a brace and she was able to get around some, but dragged especially her left leg. Nothing was done to the left hip, which remained fairly well in its displaced position with the head just below the anterior superior spine and the trochanter posterior; evidently there was a twisting of the neck and shaft.

She again applied for treatment in 1906, nine years after the previous operation. On examination the right hip was found to have again become luxated on the dorsum of the ilium. The left hip was apparently somewhat more posterior. The right hip slid up and down from one-half to one inch. In April, 1907 (thirteen months ago), the right hip was again operated on, a new acetabulum was dug out and the head inserted and the limb put up in the abducted position in plaster-of-Paris. Healing was uneventful. To correct the dropping down and in of the anterior part of the right foot the tibialis posticus, extensor proprius hallucis, and peroneus brevis were loosened and attached to the extensor longus digitorum. The distal end of the extensor proprius hallucis was attached to the tendon of the adjoining toe. On the left foot the peroneus brevis tendon was attached to the tibialis anticus, as were also the extensor tendons of the fourth and fifth toes. The distal ends of these tendons were sutured to the tendons of the second and third toes. After about twelve weeks the patient got around. Stout shoes were ordered to hold the feet firmly and a corset to support the trunk.

At present, one year after operating, she walks without cane or crutch. She has a marked paralytic eversion of the left foot with evident twist in the bones. An apparatus might be constructed to hold this foot inward, but it would have to extend from the pelvis to the foot and this she declines to wear. The hip is firm in place and movable functionally, and gives her no trouble.

CASE III.—Miss C., aged twenty years, had a congenital luxation of the left hip. She limped, but not excessively. About five years previously while walking the joint seemed to catch; since then it has ached and the pain has become so constant as to induce her to seek relief. She was operated on in conjunction with my colleague, Dr. Taylor. An anterior incision was made as in the other cases, and a place was cleared in a depression in front of the former

location and above the acetabulum, but no bone was removed. The limb was put up in plaster in abduction. At present, over a year after the operation, she walks excellently. There is no slipping of the head of the femur, and with a half inch added to the heel she is comfortable unless she unduly exerts herself, when she experiences a feeling of weakness.

These cases represent some of the worst in the domain of surgery. When a person is young, say under ten years of age, the dislocated hip can usually be replaced without a cutting procedure, but after that age attempts at reduction are apt to fail and other means have to be resorted to. Some surgeons do not regard an unreduced congenital luxation as being very serious. My experience has been different. In almost every case a greater or less amount of disability occurs in later life, in addition to the awkward gait and limited use of the affected joint inseparable from the affection. Only recently have I seen a woman, aged fifty-five years, again disabled by pains in the affected hip.

A dislocated hip is an unreliable hip that is certain to give rise to serious trouble in some portion of the patient's life. These congenital luxations can usually be reduced by the bloodless method up to about the age of ten years. Later in most of the cases it is impossible to restore the head to its socket and one is, therefore, forced to seek a new position for the head of the femur to rest in.

The treatment of congenital hip luxations has developed on two separate lines: the non-operative and the operative. It began about 1826 when Dupuytren brought forward his pelvic band. Corsets, jackets, and braces followed. The next advance was about in 1847 when Humbert, and especially Pravaz, of Lyons, advocated traction to bring the hip down and then pushing it over into place. This method was followed in a more or less modified form by Buckminster Brown, Bradford, Mikulicz, Max Schede, and others. While these traction methods were being developed, other surgeons were doing operations for the same condition.

Guerin was one of the first to cut the muscles subcutaneously; Brodhurst and others followed. Resection of the displaced head was given quite a thorough trial until, finally on January 29, 1888, Alfonzo Poggi, of Bologna, replaced the head in a new acetabulum scooped out of the side of the ilium. Two years afterward the late Prof. Hoffa brought out his well-known method of detaching the muscles about the great trochanter and making a new acetabulum. In 1892 Lorenz modified Hoffa's procedure by making an incision from the anterior superior iliac spine downward and outward along the posterior edge of the tensor fascia femoris muscle. In 1895 Hoffa, having been convinced by Trendelenburg that loosening of the muscles attached to the greater trochanter was unnecessary, made an incision along the anterior edge of the greater trochanter

from its tip down. There have been practically no further developments of the open operative method since that date. While the bloody method was occupying the attention of the surgical world, Agostino Paci, of Pisa, was publishing his work by the bloodless method from 1888 to 1893. In 1894, at the International Congress in Rome, Lorenz and Hoffa came prepared to fight for their respective cutting operations, but Paci by this time had systematized his work. He gave his results on 23 cases of congenital luxations, besides 5 of pathological and old traumatic ones; also those of 10 other surgeons who had used his method; he submitted a specimen showing a perfect antemortem reposition; and finished by performing his bloodless method on a patient before the assembled surgeons. The effect might almost be described as ludicrous. No more was heard of cutting operations. Lorenz, in the following year, modified Paci's procedure and travelled far and wide exploiting it.

The majority of congenital luxations of the hip which one now sees can be replaced by the more or less modified bloodless method of Paci, but occasionally one sees a case which it is impossible so to reduce.

A person who has only one hip luxated, as in the third case, not infrequently has such an amount of disability as to demand relief. Should such a case not receive attention before say the age of ten or twelve years (it varies considerably), then the only other alternative is an open operation or they must bear their ills as best they can. If the case happens to be a luxation of both hips one will be apt to be much worse than the other. This was the condition in Case I. The right hip though luxated was still fairly fixed in its displaced position, the left, however, was so loose and caused such pain as absolutely to disable the patient and prevent her from earning her living. In the second case there was not only a luxation of both hips, but also the results of an infantile paralysis involving both lower extremities, as well as the muscles running from them to the trunk. Of course all the muscles were not paralyzed; some escaped, and by producing an artificial ankylosis in one foot (arthrodesis) and transplanting tendons in both feet the legs were made to acquire a certain degree of stability. The effect of the paralysis of the trunk muscles was partly counteracted by means of a firm corset. The left hip at first was luxated upward and anteriorly, the head being just below the anterior superior spine; later it has assumed a somewhat more posterior position. It was not, however, loose like the hip on the right side. The deplorable condition of this child with both hips luxated, together with the extensive paralyses, can be readily appreciated.

In 1897 I had operated on the left hip of this patient by Hoffa's original operation, but several years later it was found to have relapsed. In 1899 I showed before the Philadelphia Pediatric Society a child a little over five years of age, in which one hip had

been replaced by the bloodless and the other by the open operation, with success in each case.

In each of the 3 cases reported herewith the object was to fix the head of the femur in a new acetabulum so that in walking the weight



FIG. 1.—Gouge.



FIG. 2.—Burr.

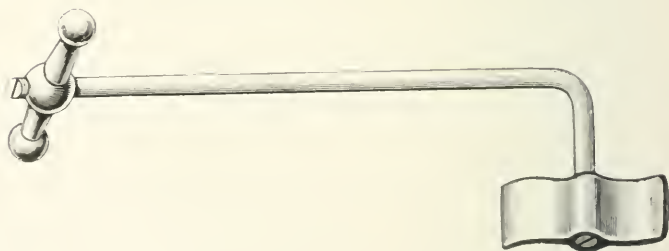


FIG. 3.—The lever for lowering the head of the femur.

of the body would be borne by the bones and not by the soft parts, and this result was accomplished. In operating for this affection the incision I prefer is an anterior one straight down from the anterior superior spine. Hoffa's incision was along the anterior edge of the

greater trochanter, while that of Lorenz ran downward and backward from the anterior spine. The reason the extreme anterior incision is preferred is because of the better access which is obtained. The lateral incisions are difficult to separate in order to work properly. In the anterior incision, if more room is necessary, we can do as advised by Codivilla—separate the structures from the crest of the ilium from the spine back as far as desired. On the completion of the operation they are to be re-attached by means of sutures of chromic catgut.

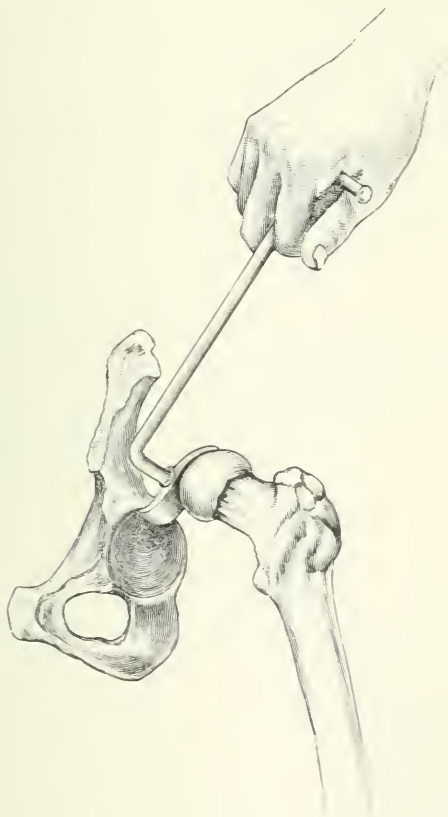


FIG. 4.—Method of replacing the head of the femur.

To deepen the acetabulum I prefer the gouge and burr devised several years ago.¹ The gouge (Fig. 1) has a round edge and is sharply bevelled on its outer side. It cuts quickly and efficiently and with it the chips are easily removed. The burr (Fig. 2) is one inch in diameter and has ten cutting teeth around one-half of its circumference only. The cutting side is used to smooth and deepen the

¹ Trans. Amer. Orthop. Assoc., 1899, p. 331.

new acetabulum at any desired spot, while the smooth side presents toward the femoral head, the cartilage covering which thereby remains uninjured. In order to facilitate lowering the head a lever (Fig. 3) was devised, consisting of a rod bent at a right angle and having a square handle at one end and a small curved plate at the other. By loosening the screws that hold the plate on, the latter can be removed and reversed for use on the opposite hip. The smaller plate is 4.5 cm. (one and three-quarter inches) long and is intended for children; the longer is 6 cm. (two and three-eighth inches) long and is intended for adults. A firm, square handle is essential to manipulate the instrument properly. In using it one end of the plate is hooked under the edge of the acetabulum, while the other end rests on top of the femoral head. By depressing the lever the head slides along the shallow groove of the plate into the acetabulum (Fig. 4). A. Codivilla, of Bologna, used a straight lever for this purpose.² A stout steel hook is also sometimes of service in lowering the head of the bone. In order to dilate and stretch the capsule and adjacent fibrous structures, the uterine dilator of Pryor (Fig. 5) has been found of service. It is very strongly constructed.

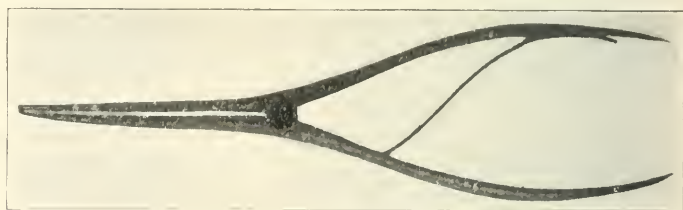


FIG. 5.—Uterine dilator of Pryor.

The incision used passes almost directly downward from the anterior superior spine of the ilium; this is between the anterior or inner edge of the tensor fasciæ femoris and sartorius muscles. I prefer this to the incision of Lorenz, which follows the posterior edge of the tensor fasciæ femoris and to that of Hoffa, who makes one along the anterior edge of the greater trochanter. One should avoid as far as possible injuring the branches of the deep circumflex artery and nerve as they cross the femur. Drainage may be used for twenty-four hours and the limb placed in a position of marked abduction in plaster-of-Paris. After eight weeks the plaster is to be removed, the limb brought down somewhat, and the patient allowed to go about on crutches.

Over two years have elapsed since the operation in the first case, and over a year in each of the other two cases, so that there is reason for hoping that the present results will be permanent. In order to avoid ankylosis it is in the highest degree desirable not to wound the cartilage on the head of the femur.

² Archives di ortopedia, 1902.

THE POSTOPERATIVE TREATMENT OF MALIGNANT DISEASE.

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THE fundamental principles upon which is based the postoperative treatment of malignant disease with the x -rays are: (1) That some of the cells of the malignant growth have been left in the tissues; and (2) that the x -rays have a selective destructive action upon such malignant cells in their location in the tissues. If the first of these two conditions be absent, no x -ray treatment is indicated, and if the second principle be not well founded, the treatment would be useless. The discussion of this subject must, of necessity, therefore, resolve itself into a discussion of these two principles. In this discussion I shall take as a type carcinoma of the mammary gland, and when no other growth is mentioned this growth is assumed to be the one referred to.

That some malignant cells are usually left in the tissues after an operation for the removal of a malignant growth is amply proved by the experience of every surgeon in the recurrences that take place. A recurrence is an evidence that some cells were left. Without the existence and the proliferation of these malignant cells a recurrent growth could not appear. So common is the recurrence that in every text-book description of malignant growths there is mentioned the classical symptom, "a tendency to recur after removal." The difficulty in removing every cell is a natural consequence of the essential character of a malignant growth. Such a tumor grows peripherally and sends out offshoots, penetrating the surrounding tissues. The invading cells find ready and easy progress along the lymphatics. The gross mass of the tumor affords no true index to the limits of the cells that are leading the advance. Since there are no means of telling the confines of the malignant cells, it is but natural that some cells should be left when the main body of the tumor is extirpated.

The tendency of the cells to advance beyond the main mass is dependent upon the richness of the surrounding tissues in lymphatics, the proliferative activity of the tumor cells, and the manipulation of the tumor, before or during the operation, which tends to dislodge cells and assist their advance in the lymphatics.

A due appreciation of the anatomy and histology of the tumor and of the surrounding parts has recently led to a great improvement in the surgeon's operative technique, increasing the chances of removing all the malignant cells. Such, for example, is the operation to remove the adjoining axillary lymph nodes, then the lymphatic channels, and finally the tumor of the breast, endeavoring to get the whole out en masse, but beginning with the lymph nodes.

When malignant cells have been carried beyond the confines of

the nearest nodes and have invaded the circulation and been carried to distant parts, the possibilities of reaching them becomes correspondingly more difficult, because of the uncertainty of their existence and location.

The statistics of the surgeons each year show a steady diminution in the number of recurrences after operation. Twenty years ago practically every carcinoma of the breast that was removed was followed by recurrence or metastasis. Last year, at the meeting of the American Surgical Association in the symposium on "Carcinoma of the Breast," the recurrences reported varied from 23 per cent. to 80 per cent., the variation depending upon the operator, the operative technique, the stage of the growth when removed, and the length of time over which the observation extended.

After taking into consideration all these points regarding a thorough operation, the balance of the evidence is still strongly in favor of the probability that some malignant cells will be left in the tissues, from which a recurrence may arise. Since, then, it is necessary to destroy these remaining malignant cells to prevent a recurrence, and since the chances are that such cells do remain, it therefore becomes our duty to act upon the assumption that malignant cells are left in the tissues and to pursue that treatment which will completely eradicate them.

Our discussion now reverts to the question as to whether we have in the x -rays an agent that will accomplish this much-desired object. Even the most skeptical will acknowledge that the x -rays will heal superficial carcinomas. Many of us have seen them heal carcinomas more than an inch from the surface, and this without even producing a reddening of the overlying skin, thus giving evidence that the effect is a selective action upon the malignant cells. Microscopic study of such tissue will show granular disintegration of the actively proliferating cells of the carcinoma, while the protective resistant epithelial cells of the skin appear unaffected. A larger dose of the x -rays will finally produce in these latter resistant epithelial cells the same changes that are found to occur in the malignant cells with a smaller dose. The readiness and ease with which superficial carcinomas or epitheliomas heal without producing destruction or even redness of the surrounding tissues is evidence of selective action of the x -rays.

The question of recurrence after apparent healing with the x -rays rests upon the same principle as that of healing by any other procedure, namely, whether any malignant cells were left undestroyed. If the rays will destroy so many of the cells that there will be a disappearance of gross evidence of the growth, then by the continuation of the same destructive influence of the rays it is only reasonable to assume that all histological trace of the growth, or the last remaining malignant cell will finally disappear. When this is the case there cannot possibly be a recurrence. This is proved by

the fact that many cases so treated have not had a recurrence after many years, and consequently no malignant cells could have been left.

If the cells that are left were on the surface they would be readily destroyed, as we know to be the case with cells of all superficial carcinomas. Unfortunately the cells that may be left after an operation lie deeper in the tissues, and the difficulty in reaching them is in proportion to their depth. It could be argued that if the rays can be relied upon to destroy cells deep in the tissues, why should the rays not be relied upon to destroy the primary or original growth and so render surgical intervention unnecessary. The answer to this is in the fact that the cells of a primary growth are farther from the surface than are those cells that may be left after the tumor mass and other tissues have been removed. After such an operation no malignant cells are more than an inch and half from the surface unless they have invaded the intercostal spaces or deeper lymphatics. Unquestionably, the *x*-rays given in proper dosage can be relied upon to destroy malignant cells this distance from the surface. Many instances have occurred in which growths deeper than this have been made to disappear. The fact that *x*-rays can affect nodules this distance from the surface is well known by every Röntgen operator who has treated many recurrent growths of the breast. When such nodules disappear, it means that the malignant cells composing it have been destroyed and the detritus absorbed.

If some cells are destroyed, then why will not all be destroyed if within this distance and subjected to the same destructive influence? The answer is clearly that they will be. If, however, the distance is greater, or if the cells lie behind structures of greater density, such, for example, as the sternum or the ribs, the chances are that the malignant cells will not be destroyed. The following case is of interest: I treated a recurrent nodule over the sternum which was rapidly disappearing under *x*-ray influence, when symptoms of general carcinosis developed, and the patient died. The postmortem showed the practical disappearance of the nodule treated, but behind the sternum was a large carcinomatous mass which was unchecked and invading the lung. In addition to this mass there were metastatic growths in nearly every other internal organ. Such is the nature of a carcinoma. If the cells have wandered from the parent growth beyond the limits that are accessible to the *x*-rays, the postoperative treatment is useless, but if cells are left within this accessible zone they can be destroyed. Unfortunately we have no definite means of telling just after the operation whether or not cells have already wandered beyond this accessible zone through the intercostal spaces or to distant parts.

For this reason all prognosis must be guarded. In a large proportion of cases we know from experience that remaining malignant

cells are likely to be only in this accessible zone. It, therefore, is clearly our duty, if we would give the patient the greatest chance for complete eradication of the malignant growth, to give post-operative x -ray treatment.

As to the action of the x -rays in blocking the lymphatic circulation by producing proliferation of the endothelial cells and by the formation of fibrous tissue with its consequent contraction, this is a possibility stated by some observers, but the more rational basis seems to me to be the proved direct selective action of the rays upon the malignant cells.

In regard to the practical application of the x -rays in postoperative treatment, my own method is based upon the assumption that there are scattered through the area accessible to the destructive influence of the rays very small masses of malignant cells. By experience we know that small recurrent nodules can be made to disappear in two or three series of exposures, each series having about five exposures, and each exposure being of ten to fifteen minutes duration at ten inch distance, the milliamperage in the secondary being $\frac{3}{4}$ to 1, and the penetration of the tube necessary according to the Benoist scale 4 to 5. The exposures in a series are given daily. A series is about sufficient to produce an erythema. A week to two weeks elapse between series, in order to give time for the erythema to develop and fade. Two series will be usually sufficient. In far advanced cases it is probably safer to give three or more series, as the remaining cells may be more numerous and deeper in the tissues. The x -ray treatment should be begun about five days after the operation. I think it better to wait until primary union has a good start before applying the rays, because the rays may retard the union, as it undoubtedly has a decidedly destructive influence upon all actively proliferating cells. The granulation tissue or the reparative tissue that brings about primary union comes under the rule concerning the selective action of the rays, which rule is that the rays affect a tissue in proportion to the density of cells and in proportion to the proliferation or functional activity of such cells. For this reason union should have at least five days start before applying the rays.

The reason against an exposure two or three times a week for several weeks or months is that such small dosage is not sufficient to destroy the cells. It simply may retard their development so long as the treatment is kept up. If cells are to be destroyed, a certain dosage must be given in such short time that the influence will be cumulative and the total cumulative dose sufficient to produce a destructive effect. I have found such procedure satisfactory in treating superficial carcinomas and known recurrent malignant nodules. Too great stress cannot be laid upon the necessity of every x -ray operator knowing his apparatus so that he can foretell the results of different dosage.

In conclusion, I may say that postoperative x-ray treatment of malignant disease is indicated because in every attempt to remove surgically a malignant growth the chances are that cells of the growth have been left in the tissues, and also because we have in the x-rays an agent that in a large proportion of the cases will completely destroy these cells. It, therefore, becomes our duty to give the patient the increased chances of a permanent cure.

THE DIFFERENTIATION OF COMMON TYPES OF PROTRACTED FEVER.

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THE anxiety aroused by the presence in a patient of a continued fever for which we can find no adequate cause is well known. Of recent years a number of interesting and instructive cases of this character have come under observation in the Presbyterian Hospital, and a review of them may prove of value. We may classify these cases under the following heads: (1) Typhoid fever, (2) tuberculosis, (3) septicemia, (4) influenza, and (5) unexplained fever. The absence of malaria from this list may be thought remarkable, but it is now established beyond question that in this latitude malaria can easily be recognized by the examination of the blood and the use of quinine. A fever which shows no parasites in the blood and does not yield to quinine is not malaria. We have therefore no longer any difficulty from that source.

1. TYPHOID FEVER. Protracted cases of typhoid fever are not uncommon. McCrea gives the average duration of the primary attack as twenty-nine days, but it may well be prolonged to forty or fifty days. We have in our records one case of sixty days, and longer cases are reported. Such prolongation of the fever always gives rise to anxiety, although, as a rule, if the fever is the chief consideration we may be confident of a favorable outcome. The greatest cause of anxiety in these cases is usually that of diagnosis. As the fever is protracted beyond its usual limits we begin to question whether the diagnosis is certain, whether we may not be dealing with some other disease, such as tuberculosis or septicemia. In the days when we were forced to rely wholly upon bedside observation this uncertainty often gave rise to great anxiety. The aids brought to our assistance by the clinical laboratory have naturally lessened our difficulties. By means of the diazo reaction, the leukocyte count, the Widal reaction, and blood cultures, the diagnosis of typhoid fever can now

be established with such certainty that there is rarely ground for doubt. We sometimes fall into error by persisting in regarding a case as typhoid fever despite the negative evidence of these various tests. If in any case believed to be typhoid fever we have not by the end of the third week obtained satisfactory evidence, from clinical observations and laboratory tests, of the correctness of that diagnosis, we had best seriously review it.

The question naturally arises, What is satisfactory evidence of typhoid fever in the cases of protracted fever of which we are speaking? The enlargement of the spleen so often made much of belongs also to the diseases with which typhoid fever is most likely to be confused—tuberculosis and septicemia. It is perhaps more frequent in typhoid than in either of the other fevers, but not sufficiently so to render its presence of definite value. We may say the same of the abdominal symptoms—distention, tympanites, diarrhœa. In short, on the clinical side the symptom of most help is the typhoid roseola. In the Johns Hopkins cases of typhoid the eruption was found in 93 per cent. of the white patients, in 55 per cent. of the black. Taken in conjunction with other symptoms suggestive of typhoid it may be safely accepted as determining the diagnosis. The characteristic rash consists of small, round, discrete, rose-colored spots, varying from 2 to 4 mm. in diameter, disappearing on pressure either flat or sufficiently raised to be definitely felt above the surface, developing in successive crops on the abdomen, chest, or back. They usually appear during the second week, but it is to be remembered that they may not appear until much later—in some cases not until the fever has subsided. The bright color of the spots seen on their appearance fades gradually in three to five days, leaving possibly a slight brownish pigmentation. The typhoid spots never become vesicles or pustules and are never acuminate. They are therefore easily distinguished, as a rule, from chance eruptions of acne, miliaria, and the like. No such spots are seen in the other fevers here under consideration. The only prolonged fever in which spots not easily distinguished from those of typhoid fever do occur is trichinosis, but this affection is readily recognized by other features, especially the œdema of the face, pains, leukocytosis, and eosinophilia.

Of the laboratory tests, the diazo reaction is of slight value. It is more frequent in typhoid than in other fevers, but not sufficiently so to render its presence more than suggestive. A persistently low leukocyte count, with or without a relative lymphocytosis, belongs to typhoid fever and tuberculosis. The Widal reaction, if obtained repeatedly by a qualified observer, ought to be pathognomonic. Its continued presence in a doubtful case is regularly decisive. While we know that the reaction may be absent in some cases, we also know that it is found at some period of the fever in 95 per cent. of the cases in which it is carefully sought. Its value in a case of doubtful protracted fever is therefore great.

The demonstration of typhoid bacilli in the blood is, of course, conclusive. Equal importance attaches to the demonstration of the bacilli in the urine or cerebrospinal fluid, or even in the feces. The cultivation of the bacilli from any of these sources is, however, attended with considerable practical difficulty. When one has access to a first-class laboratory and an experienced bacteriologist, these procedures may clear up a case which would otherwise remain a puzzle.

The following case well illustrates the difficulties of diagnosis even when every resource at our command is employed, and the value of the Widal reaction and blood cultures when positive results are obtained:

CASE I.—M. B., aged forty-six years; a housewife. She had had a chronic endocarditis for some years, and was treated in the Presbyterian Hospital from April 3 to May 12, 1907, for lobar pneumonia and chronic endocarditis. She was readmitted on September 27 on account of an increase in her symptoms of cardiac failure. Under treatment her condition improved. The temperature was practically normal until October 20, when she had a chill and a sudden rise to 104° . At this time the pulse, previously ranging from 60 to 80, rose to 96 to 108, and her dyspnoea was somewhat increased. Nothing in the physical examination at this time explained the chill and fever. For two days following the chill the temperature was moderately high, 101° to 103° , then it rose again, and remained from 102° to 105° for many weeks. The pulse remained rather slow in proportion to the fever. The spleen became enlarged so that it was easily palpable. The abdomen was distended and tympanitic. The bowels were constipated. At times the patient's mind was rather dull, but not remarkably so. She sweated profusely. The diagnosis lay between typhoid fever (acquired in the ward) and an added infection of the endocardium (malignant endocarditis). For five weeks there was no material change in the conditions. During this period the urine regularly gave the diazo reaction of Ehrlich; the leukocyte count ranged from 10,000 to 12,000, but on one occasion sank to 6000. Repeatedly trials of the Widal reaction resulted negatively, and two blood cultures gave no growth. Neither the characteristic roseola of typhoid nor the petechial rash of malignant endocarditis appeared. On the whole, the clinical course seemed to favor the diagnosis of typhoid fever, but the rarity of typhoid infections in the hospital and the absence of conclusive evidences of typhoid kept us in doubt. On the other hand, the suddenness of the onset and a certain intensification of the signs of the chronic endocarditis strongly suggested the possibility of malignant endocarditis, and none of the findings were conclusively against that diagnosis. On the thirty-seventh day of the fever the Widal reaction was obtained, and this finding was confirmed three days later, while a blood culture taken on the thirty-sixth day gave a

growth of the typhoid bacillus. The patient finally succumbed in the ninth week of the fever, and the autopsy confirmed the diagnosis thus tardily established.

The further consideration of the differential diagnosis will be taken up in connection with the discussion of the types of protracted fever.

2. TUBERCULOSIS. The tuberculosis which belongs to our subject is the acute miliary form, of which there are two fairly distinct types: (1) The typhoid, and (2) the pulmonary. A summary of two cases illustrating these types follows:

CASE II.—H. G., aged twenty-seven years; admitted June 23, 1904; died August 3, 1904.

History. Family: Negative. Personal: Negative. Previous: Pleurisy five years ago for one week. Gonorrhœa one and one-half years ago. Present: For two weeks easily tired and lacking in energy; nine days in bed on account of headache, backache, and fever. He has felt better, but remained in bed on orders. On admission, temperature, 104°; pulse, 72; respirations, 20. Physical examination at this time entirely negative.

Course. Continued fever, from normal to 105°, eight weeks in all. Usually from 100° to 102° to 103°. Pulse from 72 to 100, more rapid and feeble at end. Respirations, 20 to 28. Loss of flesh and strength, exhaustion, moderate anemia.

Physical Signs. Spleen became palpable. No distention or tenderness of abdomen. No eruption. Signs of a slight general bronchitis.

Laboratory Tests. No Widal; no diazo; blood cultures negative. Cultures from feces, no typhoid. Sputum always negative, rarely obtained. Urine negative.

BLOOD EXAMINATIONS.

	June 23	June 29	July 6	July 7	July 17	July 19	July 22	July 26
Hemoglobin	50.0%				
Red cells	4,136,000				
Index	0.61				
Leukocytes	6000	5200	4000	5000	4300	3600	7300	4300
Polynuclears	80.0%	.....	.....	.....	97.0%
Large mononuclears	1.0%				
Small mononuclears	18.0%	.....	.....	.....	3.0%
Eosinophiles	1.0%				

Autopsy. Acute general miliary tuberculosis.

It is to be noted that in this case we found the leukopenia regarded as characteristic, but the differential counts showed in one instance

a definite increase of the polynuclear leukocytes, and in the other an overwhelming predominance of these cells.

CASE III—L. S., aged twenty years; admitted April 3, died June 24, 1906.

History. Family: Good. Personal: British Guiana until six months ago, when she came to New York; otherwise negative. Previous: Measles, whooping-cough, dysentery in childhood; dyspepsia for six months. Present: For one week not well, "caught cold," tired and easily fatigued; two days ago a chill, headache, and fever; the same afternoon a second chill; in bed since onset; complains only of fever, headache, prostration, anorexia, and constipation. On admission, temperature, 102° ; pulse, 102; respirations, 20.

Course. Continuous fever, 100° , 102° , and 103° , rather irregular in type. Fever in all lasted three months. Pulse rather rapid, 80 to 100 to 120. Respirations, 20 to 30; in last weeks 30 to 40. Gradual loss of flesh and strength and increasing anemia. Always comfortable and cheerful.

Physical Examination. Entirely negative at beginning, except palpable spleen. April 30, by Dr. Baldwin, of Saranac, no pulmonary lesion. June 14, signs of a general bronchitis.

Ophthalmoscopic examination by Dr. Parker: one small area in right eye suggestive of miliary tubercle.

In final weeks occasional cyanosis of fingers and lips, gradually deepening and becoming continuous.

Laboratory Tests. Widal always negative; blood cultures negative; feces cultures negative. No malarial organisms in blood. Urine: 1015 to 1025, albumin, faint trace, rarely casts, no pus. Diazo reaction repeatedly positive.

BLOOD EXAMINATIONS.

	Hemoglobin. Per cent.	Red cells.	Index. Per cent.	White cells.	Polynuclears. Per cent.	Transitionals. Per cent.	Large mono- nuclears. Per cent.	Small mono- nuclears. Per cent.	Basophiles. Per cent.	Eosinophiles. Per cent.
April 3 . . .	78	6,024,000	0.68	8,100	82.0	0.5	2.0	15.5		
April 4 . . .	...	.....	.....	9,600	64.0	5.5	0.5	23.5	.....	6.5
April 7 . . .	...	.....	.....	.....	82.0	.....	10.4	6.0	0.4	1.2
April 24 . . .	76	.....	.....	13,800	84.5	1.0	3.0	10.5	0.5	0.5
May 6 . . .	77	.....	.....	16,100						
May 8 . . .	...	.....	.....	16,300						
May 10 . . .	...	.....	.....	.....	72.0	3.0	8.0	14.0	.....	2.5
May 12 . . .	...	.....	.....	.....	74.5	1.5	11.5	16.5	.....	2.5
May 22 . . .	...	.....	.....	10,500	82.0	4.0	2.0	7.0	.....	5.0
June 8 . . .	69	4,704,000	0.73							
June 22 . . .	...	.....	.....	19,000						

Autopsy. Acute general miliary tuberculosis, the lungs crowded full of miliary tubercles.

Special attention is called to the variability of the leukocyte count, both absolute and differential. Out of seven counts, only one, that of April 4, gave what is commonly stated to be the characteristic blood picture of acute miliary tuberculosis, an absence of leukocytosis, with an increase in the proportion of lymphocytes. The rapid variation of the differential counts indicates the need of great caution in interpreting the meaning of any one of them. The most careful examination of the lungs as late as April 30, more than a month after the onset, gave no signs, although at that time there must have been large numbers of miliary tubercles in the lungs.

The resemblance of the first type of acute miliary tuberculosis to typhoid fever is so close that for weeks a differential diagnosis is usually impossible. They have in common the fever, prostration, gradual emaciation, and slowly increasing anemia. Each shows an absence of leukocytosis, or leucopenia, with usually an increase in the percentage of lymphocytes. Either may give the diazo reaction. Either may show moderate enlargement of the spleen. Either may have tympanites and diarrhœa. Miliary tuberculosis with intestinal lesions (ulcers) may even show blood in the stools. Either may give a Widal reaction. The resemblance is so close that in some cases a decision between them must be left to the autopsy.

In most cases, however, we can by care anticipate the conclusion. Acute miliary tuberculosis of this type looks like mild typhoid fever, but it may be distinguished by these points:

1. A previous tuberculosis of any part of the body.
2. The fever of miliary tuberculosis is more irregular than that of typhoid. It shows a greater daily variation: it may be low all of one day, to rise again the next; it more frequently shows sudden brief drops to normal or below with quick recovery.
3. When a typhoid fever of similar severity would be improving, the patient with miliary tuberculosis is stationary or still failing. Thus, at the end of the third or fourth week the temperature, instead of falling, continues or runs a higher course.
4. Hemorrhage from the bowels in any degree, although it may occur, is most uncommon in tuberculosis.
5. Of the decisive features of typhoid fever mentioned above, the roseola, the typhoid bacillus in the blood or excreta are absent.
6. The possibility of the occurrence of a Widal reaction in tuberculosis, especially the acute miliary form, must be admitted. The reaction in these cases, while not altogether typical, so closely resembles that obtained in typhoid that even the most skilled observers find difficulty in distinguishing them, and the inexperienced may see no difference. It still remains true that the repeated finding of the Widal reaction is more characteristic of typhoid than of tuberculosis.¹

¹ Wood, Chemical and Microscopic Diagnosis, p. 236

The second (pulmonary) type of acute miliary tuberculosis is much like the preceding, and presents the same difficulty of diagnosis for weeks. The careful observation will regularly disclose some important points:

1. Attacks or periods of cyanosis of the lips (and other mucous membranes) and the finger tips. This cyanosis is at first slight and variable, quite definite at one time, then disappearing entirely for a time. It is not caused by any ascertainable disturbance of the circulation; the pulse remains the same. It is free from any distress on the part of the patient—in fact, the comfort of the patient, despite the definite cyanosis, is quite notable.

2. The signs of diffuse bronchitis, which belong to typhoid fever and tuberculosis in the early stages, instead of gradually clearing up as they should in typhoid, gradually increase. The expansion of the chest and its resonance are slowly and insidiously impaired, yet without definite areas of consolidation. It is often amazing at autopsy to find a lung packed with miliary tubercles, which have given no pronounced signs during life.

3. The periods of cyanosis become more frequent and longer until the symptom becomes continuous. The respiration quickens gradually, but to the end there is no real dyspnoea or distress.

4. The cough is always much less than the signs would lend us to expect, and may be absent even to the end. Similarly, expectoration most often is lacking, and even when present does not show bacilli.

In connection with this question of the diagnosis of tuberculosis mention may here be made of the test reactions of von Pirquet and Calmette. For some reason not yet satisfactorily explained both these reactions fail in acute miliary tuberculosis, so that they are not of value in the cases we are at present discussing.

3. CRYPTOGENIC SEPTICEMIA. The third common cause of protracted fever, and in our experience much the most frequent one, is cryptogenic septicemia. When we have to do with fever in association with suppurating wounds, an infected uterus, large abscesses, etc., the explanation of the fever is, of course, easy. In the group of cases to be here considered, however, the origin of the septicemia is not revealed and the search for it is often futile.

The cases which belong in this group may be readily classified. (1) Blood infections; malignant endocarditis; pyogenic organisms found in blood. (2) Local infections; latent; no organisms in blood; symptoms produced by absorption of toxins from some hidden focus of suppuration, which finally develops into a localized abscess, such as abscess of the liver, perinephritic abscess, or empyema.

The following abstracts of cases illustrate these different types:

CASE IV.—*Malignant Endocarditis*. F. M., aged eleven years; admitted September 25, 1907; died October 1, 1907.

Previous history of chorea and rheumatism, pneumonia, and measles. Present history: For ten days before admission she had

had fever and headache and had occasionally been delirious. On her admission her temperature was 103.8°; pulse, 120; respirations, 48.

The physical examination at this time showed marked apathy and prostration, a coated tongue, an enlarged heart with systolic murmurs at the base and apex, a rapid pulse, but of good quantity, the abdomen distended and tympanitic, and an enlarged and palpable spleen.

The leukocytes on admission were 15,200. The clinical diagnosis at this time was typhoid fever. During the following six days the temperature was continuously high, ranging from 102° to 105°, the curve being altogether like that of most severe typhoid fever. The pulse grew steadily more rapid and weaker and the apathy and prostration deepened. In a general way the course was that of severe typhoid. But on the 29th, four days after admission, the leukocytes were found to number 31,500 and a differential count showed 87 per cent. polynuclears, 1 per cent. transitionals, and the mononuclears, large and small, only 12 per cent. On the same night a number of petechial spots appeared on the chest and side of the neck. Later, paralysis of the right side developed. The cardiac signs became more pronounced. Finally, a blood culture taken three days after admission showed abundant growths of staphylococci.

The rise in the leukocyte count on the 29th showed that the case was not uncomplicated typhoid fever, while the rapid evolution of the petechial eruption and subsequent paralysis indicated clearly a malignant endocarditis. The result of the blood culture confirmed this diagnosis.

CASE V.—S. M., aged nineteen years; factory hand; admitted November 9, 1905; died June 21, 1906.

History. Family: Negative. Previous: Heavy lifting in room at high temperature. Malaria two years ago. Present: For four months feeling poorly. Hands and feet cold and chilly sensations at times. He had no dyspnoea, oedema, or shortness of breath. Bowels constipated. No nausea or vomiting. As he did not improve, he went to a physician, who told him he had heart trouble and that he had better stop work and take a rest. Since then he has been getting up late in the morning, and has rested much during the day, but without benefit. His chilly feelings continue. He has palpitation when he attempts to get about, and is occasionally dizzy. No dyspnoea; marked anorexia, but no nausea or vomiting. No nose bleed or headache. Stools normal. All this time he has had fever and sweated a good deal at nights.

Physical Examination. Heart: Apex impulse maximum in fourth space two and three-quarter inches to left of midline, and in fifth space three inches to left of midline. Left limit of dullness corresponds. No enlargement made out. Action regular, forcible, not rapid. At the apex there is a soft blowing systolic murmur transmitted to the axilla and heard behind, and also over whole pre-

cordium, being more accentuated over the pulmonic area. Basal sounds are clear, the second pulmonic being the louder.

Pulse regular, a little rapid, good force and size, soft, wall palpable, markedly dirotic, marked pulsation of arteries in neck. Examination otherwise negative.

Course. During the seven months of his stay in the hospital this patient had more or less daily fever. At times the fever would be slight, but usually the temperature at some time of the day would reach 101° to 103° or 104° . During the early weeks the fever was continuous; later it become irregular and much of the time intermittent in type. The more important features of the daily notes are given below. The condition of the heart remained throughout practically the same. The patient's friends finally insisted upon removing him from the hospital, and the later history is not known.

BLOOD EXAMINATIONS.

	Hemoglobin, Per cent.	Red cells.	Leukocytes.	Polynuclears, Per cent.	Large mono- nuclears, Per cent.	Small mono- nuclears, Per cent.	Transitionals, Per cent.	Eosinophiles, Per cent.	Basophiles, Per cent.
November 9 . . .	55	3,200,000	6,200						
November 10	12,000						
November 20	8,700						
November 28	10,000						
December 22 . . .	72	3,840,000	19,000	76.0	7.5	12.5	2.5	1.5	
December 29	12,100						
January 2 . . .	50	3,272,000	13,200	76.0	7.0	14.0	2.5	0.5	
January 9	8,100	84.5	2.5	11.0	1.5	0.5	
January 15	77.5	4.0	14.5	3.0	1.0	
January 24	10,300						
February 12	16,100	76.5	2.0	11.0	5.0	0.5	
March 6	14,300						
March 30	19,600	90.0	0.5	6.5	2.5	0.5	
April 16	8,800	71.0	0.5	19.5	7.0	1.5	0.5
April 24	22,400						
May 22	9,400						
June 16	11,800	89.0	0.5	5.0	5.5		

November 25, a systolic thrill at apex. November 29, spleen palpable. December 1, pain in left hypochondrium; spleen large. December 15, a few petechial spots on abdomen. January 1, murmurs same. January 2, a few new petechial spots. January 15, more petechiæ on chest and back. January 22, severe abdominal pain; heart same. January 26, pain in left shoulder. February 14,

from time to time new petechiae appear. March 1, red blood cells in urine and tenderness over left kidney. March 14, temperature normal for several days. March 30, temperature not above 100° for two weeks. April 9, temperature not above 100° for two weeks. May 16, temperature shows occasional shoots to 102° . June 7, fever irregular; some burning pain on micturition and blood in urine.

A blood culture on November 28 was negative; a second, on December 22, yielded a pure growth of *Staphylococcus pyogenes aureus*.

Urine, 30 to 70 ounces; average, 50 ounces; specific gravity, 1015 to 1020; albumin, trace, to 24 to 31 per cent.; hyaline and granular casts; rarely blood and blood casts.

Comparison of the results of the blood counts, especially the absolute and differential leukocyte counts, with those of the second case of acute miliary tuberculosis shows that the only notable difference lies in the more marked reduction of hemoglobin in the latter case. The leukocyte counts show closely similar variations both in totals and in the distribution of the several types.

CASE VI.—*Perinephritic Abscess*. J. M., aged twenty-three years; iron worker; admitted June 3, 1907; transferred June 18, 1907.

History. Family, previous, and personal irrelevant. Present: For three months complaining of bloating and pain in the abdomen, the latter not related to taking of food. For three weeks more or less vomiting of mucus. At one time he vomited a small quantity of blood. He has some pain low in the left side on deep breathing. On admission, temperature, 101.2° ; pulse, 92; respirations, 21.

Physical examination at this time elicited nothing of importance. The patient looked as though uncomfortable, but was thought to be exaggerating his sufferings.

Course. Fever continuous, 100° to 104° ; daily variation, 2° to 3° ; duration in all about one month. Pulse, 72 to 96; respirations, 20 to 24.

BLOOD EXAMINATIONS.

	Hemoglobin. Per cent.	Red cells.	Leukocytes.	Index. Per cent.	Polynuclears. Per cent.	Large mono- nuclears. Per cent.	Small mono- nuclears. Per cent.	Eosinophiles. Per cent.
January 1	14,200					
January 5 . . .	80	1,200,000	10,000	1	77	7	15	1
January 8	10,600					
January 9	12,500					
January 12	17,100					
January 13	16,100					
January 16	23,100					

At the end of two weeks patient developed some swelling and tenderness in the iliolumbar region. He was transferred to the surgical side, and a perinephritic abscess of some size was evacuated. Growth from abscess showed *Micrococcus pyogenes aureus*. Recovered promptly. Not until the development of the local signs was it possible to make the diagnosis.

Attention is called especially to the low total leukocyte counts in the first week and the normal differential count.

CASE VII.—*Abscess of the Liver*. F. S., aged thirty-five years; admitted May 6, 1904; transferred June 13, 1904.

History. Family and previous personal history of no help. Present: Began twelve days before admission with headache, malaise, and pain in the bones. Fever constant from 101° to 103° . For one week some pain on right side on deep inspiration. On admission, temperature, 100° ; pulse, 96; respirations, 24. Physical examination at this time entirely negative.

Course. A continuous fever ranging from 100° to 105° ; daily variation of from 2° to 3° ; lasting about seven weeks before its origin was made out. Pulse, 80 to 100; respirations, 20 to 24.

BLOOD EXAMINATIONS.

	Leukocytes.	Polynuclears. Per cent.	Large mono- nuclears. Per cent.	Small mono- nuclears. Per cent.	Basophiles. Per cent.	Eosinophiles. Per cent.	Lymphocytes. Per cent.
May 6	19,300						
May 9	18,800						
May 15	17,500						
May 18	10,400						
May 19	12,200	72.4	7.6	18.8	0.4	0.8	
May 22	15,200						
May 23	16,500						
May 25	14,200						
May 27 . . . . .	.....	73.0	8.0	.....	.....	1.0	1.8
May 28	14,800						
May 30	13,600						
June 3	14,200						
June 5	14,000						

Blood culture, May 27, negative,

Urine, sputum, and feces frequently examined without result. Gradually increasing resistance in right upper quadrant of abdomen and some slight tenderness there. Patient became weaker

and more anemic; was transferred to the surgical division, and operation disclosed an abscess of the liver.

In this case we note that after three fairly high counts the leukocytes sank to a rather indeterminate level and that both differential counts were normal.

CASE VIII.—*Subphrenic or Retrohepatic Abscess.* J. L., aged eighteen years; oiler; admitted November 23, 1904; transferred December 22, 1904.

History. Family and previous history of no aid. Present: He has had a cold and cough for some time. Three months ago he stopped work on account of abdominal pains, general in distribution, but most marked in umbilical region. Sometimes these pains shifted to the right side of the abdomen, especially if he slept on that side. The pains were most likely to come on after meals and were accompanied by bloating, but they also came when he was at work and interfered with his work. His appetite has been normal, his bowels very constipated. During his three months' illness he has lost twenty pounds in weight and much strength. For at least three weeks of this time he has wakened nearly every night with fever and chilly sensations. At one time his temperature reached 104° according to his physician. The pain in abdomen radiates at times to chest and shoulder (right). On admission, temperature, 99.8° ; pulse, 92; respirations, 24. Physical examination at this time showed only a marked anemia; no cause for fever.

Course. Intermittent fever, from 97° to 104.8° , with frequent chills, lasting at least seven weeks before origin was found. Pulse rapid with chills, but usually 80 to 90; respirations, 20 to 30.

BLOOD EXAMINATIONS.

	Hemoglobin. Per cent.	Red cells.	Leukoocytes.	Polynuclears. Per cent.	Large mono- nuclears. Per cent.	Lymphocytes. Per cent.	Basophiles. Per cent.
November 24	90	.....	13,400				
November 25	13,300				
November 28	70	3,904,000	11,000				
December 2	10,600	64	10	26	
December 5	18,000				
December 6	16,000	72	9	18	1
December 8	14,300				
December 10	14,600				
December 11	16,500				
December 16	9,100				
December 17	9,600				

The patient gradually became weaker and more anemic. To careful observation there seemed some slight enlargement of the right side in region of liver. There was occasionally a moderate epigastric tenderness, but the signs were so slight and variable that it seemed not wise to attach too great weight to them.

At one time, on account of cough, expectoration of mucus, and a few localized rales, it was thought that he must have pulmonary tuberculosis. We were, however, finally convinced that the trouble lay in the region of the liver. He was transferred and operated upon, an abscess being found posterior to and involving the right lobe of the liver. The patient finally died of exhaustion resulting from profuse hemorrhage from the liver wounds. Cultures from abscess yielded *Staphylococcus pyogenes albus*.

Again we see that in the case of a suppurative inflammation the leukocyte count only once in eleven times rose to a level regarded as suggestive of pus. One of the two differential counts suggested tuberculosis, the other was normal. In the early weeks of observation in the hospital tuberculosis seemed the most probable diagnosis. The gradual enlargement of the right side of the thorax, the marked anemia, rather frequent chills, and sweating ultimately led to a correct diagnosis.

CASE IX.—*Empyema*. F. D., aged four years; admitted October 25, 1907.

History. Family: Negative. Previous: Pneumonia two years ago and in January, 1907. Dry cough since. Attack of pain in right lower quadrant abdomen lasting one week in May, 1907. Present: Fever and pain in abdomen since October 6. Occasional vomiting and cough. Pain agonizing at times. Chills repeated. On admission, temperature, 103°; pulse, 144; respirations, 40.

Examination. Anemia; emaciation; tenderness right side abdomen; bulging of right lower thorax.

Course. Fever 98° to 104°; very irregular, lasting in all over a month before the cause was found; cough; vomiting; abdominal pain.

BLOOD EXAMINATIONS.

	Hemoglobin. Per cent.	Leukocytes.
October 25	65	40,000
October 26 . . . . .	...	31,000
October 31 . . . . .	...	14,500
November 8 . . . . .	...	22,700

Urine, normal; sputum, no tubercle bacilli; no reaction to ophthalmotuberculin test. Operation November 9; localized collection of pus in right pleura; pleural culture, pneumococcus.

This case is reported with interest, for here the height of the leukocyte count and the course of the fever taken with the scant indication of an apparent enlargement of the right side of the thorax

led to the suggestion that the boy had an empyema some time before physical signs justifying that diagnosis could be had.

Holt² reports a case of high temperature for three months in a boy two and one-half years of age, in whom the most careful study failed to disclose the cause of the fever. Briefly, the symptoms were fever, varying from normal to 106.2°, a little cough, slight acceleration of respiration, progressive emaciation and exhaustion, with varying signs over the lungs, never sufficient to justify the introduction of an exploring needle. At the autopsy, which was made by me, we found two small sacculated empyemas, one on the right side situated on the diaphragmatic surface of the lung near its anterior border, the other on the left side at the base of the lung and close to the spine. During the course of the fever the patient showed a leukocytosis varying from 10,500 to 28,000.

Delafield reports a similar case, the patient being a woman, whose fever lasted 234 days in all, and the empyema was found only at autopsy.

One should not leave the subject of protracted fever in children without remarking that in some instances the explanation is to be found in a suppurative pyelitis, the origin of which it may be quite impossible to explain. Difficulty in these cases arises only from failure to examine the urine. In young children especially, on account of the difficulty of obtaining the urine, the examination is likely to be omitted. I have seen one case in a child two years of age in which fever ranging from 102° to 106° and persisting for three weeks was twice attributed by a distinguished consultant to a pneumonia which failed to appear. The examination of the urine at once showed an active pyelitis, and appropriate treatment promptly put an end to the fever. Instances of such cases running months before detection are on record.

DIFFERENTIAL DIAGNOSIS. *Malignant Endocarditis.* In its typical form malignant endocarditis is easily recognized. The cardiac disturbance, with presence of murmurs, the characteristic petechial rash, and the symptoms produced by the lodgement of emboli in various parts of the body make a clinical picture easily interpreted. In some cases, however, the cardiac symptoms are so slight as to be easily overlooked or undervalued, the rash and the embolic phenomena are absent for long periods of time, and the patient shows only an irregular fever, accompanied by increasing anemia and prostration. If limited to the interpretation of the clinical symptoms, we may well find it impossible to reach a definite diagnosis in such cases. But blood cultures will, as a rule, promptly clear up the mystery. A simple culture may fail, but a second or third will almost surely detect the offending organism.

Of recent years we have had an unusual number of cases of malignant endocarditis in the wards of the Presbyterian Hospital, and the

² Archives of Pediatrics, January, 1902, p. 22.

blood cultures have been regularly successful. With relation to the cases here reported, attention is called to the following points:

1. The absence of an indication, either in the history or in the body of the patient, of the source of infection.

2. The very irregular type of fever and the long periods of comparative freedom from fever.

3. The marked anemia, progressive and accompanied by progressive emaciation.

4. The low leukocyte counts, although the blood may contain many pyogenic organisms.

5. The typical petechial eruption is of the greatest value in diagnosis. This eruption will often be found in the palpebral conjunctiva (lower lid); in some instances when it cannot be found elsewhere (Janeway).

6. The chronicity of the disease, six to nine months in some cases.

Localized Abscesses or Suppurations. In these cases the chief symptoms are those found also in malignant endocarditis: (1) Fever, very irregular in type; sometimes repeated chills and sweating. (2) Progressive anemia and emaciation. (3) Absence of any indication of the source of infection for weeks or months.

Blood cultures are, however, negative, and we may for long periods be quite unable to reach a satisfactory diagnosis, until at length the characteristic signs of a local suppuration or abscess develop. The duration of this period in these cases is quite striking. The empyema patient was under observation for a month, the perinephritic abscess gave a history of three and one half months, the retrohepatic abscess of four months. Holt's patient was under observation for three months, and then the local collections of pus were found at autopsy. In Delafield's case 234 days of fever were recorded and again the explanation was found only at the autopsy.

The diagnosis presents the very greatest difficulties. Unless we may rely upon von Pirquet's cutaneous- or Calmette's ophthalmic-tuberculin test, we have at present no reliable means of differentiating these cases from those of miliary tuberculosis. In one of the series quoted the leukocyte count was high enough (40,000, 31,000, and 23,000) to point clearly to a suppurative process, but in none of the others were the counts of definite value. The differential counts upon which so much emphasis has of late been laid as a symptom of pus in certain localities are so variable that it is quite impossible to interpret them. We must in these cases rely upon unremitting vigilance for the detection of the signs of a definite abscess or suppuration.

4. INFLUENZA. From time to time during the season when influenza is prevalent in the city we see cases of continued fever in which the best explanation of the fever is the presence of an influenzal infection without local lesion. The following cases illustrate this type of fever fairly well, though both are relatively

brief. In private practice it is not very unusual to meet such cases running for a month or more:

CASE X.—Miss S., aged thirty years; admitted February 16, 1906; discharged, well, March 18, 1906.

February 16. Entirely well until night. She had some muscular pain during night, and at 3 A.M. a hard shaking chill, followed by headache and severe muscular pains. No cough or expectoration. Physical examination entirely negative. Leukocytes, 11,500; temperature, 103° to 104° ; pulse, 110 to 120; respirations, 26.

February 17. Leukocytes 12,700. Pain in head and neck.

February 19. Temperature has been gradually falling, and is now normal.

February 23. Yesterday, without discoverable cause, temperature rose again to 102° , and the patient again complained of headache and general soreness. Physical examination negative. Leukocytes, 15,300.

February 28. Another relapse, with fever 101° , general malaise, and soreness. A differential blood count is found normal. No malarial organisms.

March 7. After four days of normal temperature patient again has had a return of fever (102°) and all her previous symptoms. Leukocytes, 15,000.

March 18. Since last note temperature has remained normal and patient has made a rapid recovery.

CASE XI.—A. McV., twenty-three years; bricklayer; admitted April 8, 1906; discharged, well, April 27, 1906.

April 3. Moderate frontal headache, anorexia, constipation, general soreness, prostration, cough, with mucous expectoration.

April 5. Severe epistaxis. Pain in shoulders and knees.

April 6. Severe epistaxis. Chilly feelings, profuse sweats, pain in right chest.

April 8. Fever reached 104° .

April 9. Admitted to Hospital. Face flushed, tongue clean, looking sick, but physical examination showed nothing more. Temperature, 103.8° ; pulse, 92; respirations, 24.

April 11. Feeling better. Some general soreness still. Cough, with free mucous expectoration. Temperature, 99° to 103.3° .

April 13. A small area of consolidation found in right middle lobe. Temperature, 101° to 103° .

April 15. After remission for forty-eight hours temperature rose suddenly to 102.5° . Pharynx congested. Inguinal glands swollen. No cause found for increase in fever.

April 16. Second sudden shoot of temperature to 103.5° . No cause found.

April 27. Temperature remained normal after last note, and patient made a rapid recovery.

The recognition of these cases is not, as a rule, difficult. They

belong to the winter season, when influenza is prevalent. They begin suddenly, usually with the characteristic symptoms, headache, general muscular soreness and pain, and prostration. They may have a cough and expectoration, and in the sputum the influenza bacillus may be found in large numbers.

It is now well understood that the presence of the influenza bacillus is not a frequent happening in the affection clinically known as influenza. The great majority of such cases do not show the influenza bacillus, but show pneumococci, streptococci, or staphylococci in large numbers in the sputum, if there is expectoration. Of course, also, many of the patients have no cough or expectoration. When, however, the organism can be found in the sputum in large numbers, the finding is of significance. The most characteristic feature of these cases is the exceeding irregularity of the temperature curve, as indicated in both these cases. The fever comes and goes in a most unaccountable manner. It is to be understood that in these cases the most careful watch must be kept to exclude the presence of complications which would explain the sudden rise and fall of the fever, such as acute otitis, mastoiditis, or involvement of the antrum or accessory sinuses. We must also recognize the fact that the fever may come and go independently of such complications. Regularly with the return or increase of the fever there is return or increase in the clinical symptoms. These patients regularly recover. In protracted cases outside of the hospital we often find that the best thing to be done for such patients is to get them out of the city.

The blood examinations in these cases have only moderate value; usually they show a slight or moderate leukocytosis ranging from 10,000 to 20,000. The differential counts, as in Case II, are all normal. Blood cultures are negative.

5. UNEXPLAINED FEVER. The history of this patient is as follows:

CASE XII.—M. S. G., aged thirty years; admitted May 10, 1907; discharged January, 1908.

History. Family: Negative. Personal: Born in Scotland; in Honolulu four years; in Trinidad one year. Menstrual: Amenorrhœa fifteen months. Previous: Measles, typhoid, dengue, tuberculosis three years ago, tonsillectomy, appendicectomy. Present: Cough, expectoration, constipation, nausea and vomiting, headache, syncope, increasing weakness. Abdominal pain and fever from January to admission.

Physical Examination. Negative except for a slight tenderness of left lower quadrant of abdomen.

From May 10 to June 1 the patient did well. She had one or two temporary rises of fever, but most of the time the temperature was within normal limits. All her symptoms cleared up, and except for constipation she felt well. From June to October she ran a continued fever of varying degree, for some days ranging from 100°

to 101°, but most of the time higher—101°, 102°, and 103°. There was an ebb and flow very suggestive of typhoid fever in the weekly curves, but none of the characteristic signs developed. There was almost constant leukocytosis, as the appended table will show, no Widal reaction, and negative blood cultures. The only suggestive thing about the physical examination was persistent tenderness over the left half of the abdomen, especially in the region of the left kidney. The urine was normal; an uncontaminated specimen was obtained and found sterile. The fever, leukocytosis, and persistent pain suggested a local suppuration, but the signs did not develop, and, the patient's condition remaining good, action was deferred. Finally, in the first week of October the fever gradually rose, and on the 10th reached 105°. With this rise there was a distinct increase in the local tenderness and pain, and an exploratory operation seemed demanded. This was done by Dr. McCosh, and a most thorough examination of the abdomen disclosed nothing abnormal whatever. Lest by any chance a minute focus in the kidney should be overlooked, the kidney was exposed through a lumbar incision and carefully examined. No lesion was found. The wounds were then sutured and the patient returned to the ward. The temperature at once fell, and within three days became normal and so continued. The patient rapidly regained her strength, and in a few weeks left the hospital quite well.

BLOOD EXAMINATIONS.

	Hemoglobin. Per cent.	Red cells.	White cells.	Polynuclears. Per cent.	Transitionals. Per cent.	Large mono- nuclears. Per cent.	Small mono- nuclears Per cent.	Basophiles. Per cent.	Eosinophiles. Per cent.
May 10 . . .	70	5,600,000	15,100	76	3.5	10.5	8.3	0.8	1.0
June 9	23,800						
June 10	25,000						
June 24	15,300						
July 27	28,000						
July 31	16,500						
August 2	18,900	84	6.0	2.7	7.3		
August 12	13,000						
August 13	12,100						
August 22	10,000						
October 1 . . .	70	4,500,000	25,000	90	1.0	6.0	8.0	0.25	0.25
October 4	17,000	76	1.0	2.0	20.0	.....	1.0
October 9	16,800						
October 10*							
October 29	15,000						

* Operation.

For this case we have at present no satisfactory explanation. The symptoms, the blood counts (the high percentage of polynuclears), and the course of the affection indicated the presence of some purulent focus. No such focus was found, yet the patient promptly recovered after operation. There was no suggestion of hysteria in the patient. Mentally she was entirely normal. Theoretically it may be possible that a minute focus of suppuration did exist in some part of the abdomen and that the circulatory changes induced by the operation brought about its cure, in some such way as laparotomy cures tubercular peritonitis; or possibly a minute focus was evacuated without detection.

Practically the case illustrates the fact that there are seen from time to time cases of protracted fever which cannot at present be satisfactorily classified.

SUMMARY. 1. Malarial fever is easily recognized by the presence of the characteristic microorganisms in the blood, and by its amenability to quinine. Fevers not conforming to these requirements are not malarial.

2. Typhoid fever can be recognized or excluded with equal accuracy by the combination of clinical and laboratory evidence.

3. Tuberculosis and sepsis of certain types present clinical pictures so closely similar that they can often only be differentiated by the ultimate outcome of the case, possibly only by autopsy.

4. Influenza may give rise to protracted fever, which can usually be easily recognized from the condition under which it occurs, sudden onset, characteristic symptoms, and course.

5. Sepsis in other cases may be clearly indicated by very high leukocyte counts, with high polynuclear percentages, before any localization of the process can be made.

6. Blood cultures are of very great value in the differentiation of fevers, especially in typhoid fever, and in such conditions as malignant endocarditis.

7. There are cases of long protracted fever which cannot at present be satisfactorily classified.

CERTAIN COMPLICATIONS OF PNEUMONIA.

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IN this paper I purpose dealing only with certain complications of pneumonia, some common, others rare, which have come under my notice, and of emphasizing certain lessons they have taught me. The first and most important lesson, which all the cases have forced upon me, is the well-known fact that pneumonia is a constitutional

disease, due, doubtless, to the effects of the pneumococcus upon the system: a true pneumococcemia. The second, which is a corollary of the first, is that to look upon the lung as the only organ affected is to be far from the mark of accuracy. Many, perhaps all, of the complications are but local manifestations of the general poisoning. Hence, if a patient is to be treated properly, each day from the beginning every organ must be watched, in order that any disturbance of its function may be recognized early and if possible corrected. Another lesson is, that some of the complications, or perhaps sequels, develop a longer or shorter time after the crisis or lysis. Some of these may be necessarily fatal, others, if recognized in time, are amenable to treatment. Hence the necessity of watchfulness after the acute symptoms are over.

Disturbance of the Renal Function. In my experience practically all cases of pneumonia which exhibit any serious constitutional disturbance show albumin and casts in the urine. The amount of albumin, the number of casts, and the amount of urine, are rather an index of the degree of poisoning than symptoms which are dangerous in themselves. One patient, however, a boy aged seven years, severely ill with involvement of one entire lung, had a veritable suppression of urine. The small amount passed was loaded with albumin and casts, and the patient suffered apparently from renal inadequacy. Other cases with less renal symptoms occur frequently. The urine, therefore, should be examined daily in every case, in order that we may anticipate any serious involvement of the kidney. The patient should be given an abundance of water. A prescription composed of: Spirit of nitrous ether, 3 drams; potassium citrate, 2 drams; lemon juice, 4 drams; and water sufficient to make 3 ounces, of which two teaspoonfuls should be given every two hours, often has the effect of causing a more abundant flow of urine and consequent comfort to the patient. If there is true suppression, dry cups to the loins, and the administration of nitroglycerin in full doses will be of the greatest value. A case on record in which a true nephritis with total suppression of urine occurred, responded promptly to infusion of digitalis.

Disturbance of the Digestive Organs. In severe cases of pneumonia, there is always more or less abdominal distention, due to intestinal paresis and to the formation of gases in the intestine. In some cases this abdominal distention is a veritable complication, being so great that the respiration and the heart action are seriously interfered with. One fatal case of the most severe poisoning that has been my fate to see, occurred in a lad aged nine years. Diarrhœa and abdominal distention were as great as in any case of typhoid fever I have observed. Nothing relieved it. Usually attention to food, milk being, as a rule, best borne, will correct the conditions. When milk itself disagrees, albumen water alone, or nothing but plain water should be given. Physostigma or eserine should be

tried, but in my hands is of little value. Salol and sodium bicarbonate, either in a combination or singly, have been the best drugs. Vomiting is troublesome in some early cases, but simple limitation of food will usually control this. There is but little danger of the patient suffering from the lack of food.

Middle ear disease is common, sometimes giving rise to mere deafness, sometimes to suppuration and its consequent dangers. The ears should be constantly examined, especially when the patient is unconscious, in order that an otologist may be summoned and the drum punctured when it shows redness and bulging. When suppuration occurs, the meatus should be kept clean by wiping with cotton and, toward the end, insufflation of boric acid.

In some cases this complication is due to the pneumococcus, in others it is the result of a simple nasopharyngeal catarrh, which is either a forerunner, or an accompaniment of the attack of pneumonia. Neglected suppuration of the middle ear, if it be due to the pneumococcus, leads occasionally to that most fatal complication, meningitis.

Cardiac Dilatation. In a certain number of cases, notably in drunkards, or in individuals whose heart musculature is weak, cardiac dilatation occurs, and is almost always fatal; it may occur when the patient is apparently doing well. The following is a typical example:

Wm. L., aged seventy-five years, was seized with a chill on December 29, 1899. On January 1, 1900, there was complete consolidation of the lower left lung. His temperature was 102°, and his pulse 96. The heart dulness was normal. The first sound of the heart was weak. On January 2, 1900, the consolidation of the lower lobe was complete. A sphygmographic tracing showed a pulse of extremely low tension, resembling that of aortic regurgitation. Suddenly, on the morning of January 3, there was rapid respiration, feeble, rapid pulse, and the entire chest became full of rales, and the area of cardiac dulness greatly increased.

Such cases are common enough. Two things are of paramount importance: (1) Absolute rest, in a recumbent posture, the patient using the urinal and the bedpan. If this rest is made imperative, there will be fewer cases of absolute sudden collapse. (2) The necessity of listening to the heart and percussing its area daily. This can be done with very little annoyance to the patient. It is of value, because usually, but not constantly, the heart dilates gradually, and this dilatation is seen in the weakened first heart sound and in increase of the area of cardiac dulness. When these signs are noted, and especially when accompanied by an increasing pulse rate, the time has come for the free use of digitalis and whiskey. When the sudden collapse is upon us digitalone and morphine hypodermically are our sheet anchors. The morphine quiets the patient and apparently stimulates the heart. Albuminuria is not

a contra-indication to its use. The use of the blood-pressure instrument is of value. If the pressure is high, nitroglycerin is of value; if low, stimulants, digitalis or digitalone, should be given. Inhalations of oxygen seem to relieve the dyspnoea, but are rarely necessary when the patient is treated in the open air.

Pericarditis and endocarditis may both occur in a small percentage of cases. Those which have come under my care were the expression of most severe systemic poisoning, and the majority have been fatal. The first case was that of a young woman, aged twenty-three years, who suddenly developed consolidation of the entire right lung and later pericarditis and endocarditis. This case ran a furious course and ended in death in a few days. Another case has recently been under my care at St. Timothy's Hospital. The patient, a woman, aged forty years, was admitted on the evening of March 23, 1908, with what was supposed to be rheumatism. Her temperature was 99.2°. By morning she was complaining of severe precordial pain and was restless. Her temperature at my visit at noon was 100.6°. On examination, the heart dulness above and to the right was normal. There was a very marked to-and-fro friction rub. There was consolidation of the entire lower lobe of the left lung. The patient became rapidly weaker. The temperature never rose above 103°. The heart gradually dilated and the patient became markedly cyanosed, and died on the fourth day after admission. In this case ice-bags to the p. cordium gave more relief than any other measure. Manifestly the treatment of this condition, when due to a local manifestation of the pneumococcic involvement, must be entirely symptomatic. Morphine was used with apparently good effect, but did not give as much relief as the ice.

Arthritis. This same patient developed the very rare condition, arthritis. Practically every joint of all the extremities was involved. On the day after admission she complained bitterly of pain in her knees. Both knees were swollen and red. The next day the swelling was less in the knees, but the arms were affected. On the day before death every phalangeal joint of both hands was swollen, dark, dusky red, and exquisitely painful. The fingers and hands were in a semiflexed position and could not be used by the patient. No culture was made from the joints, but the condition seemed the direct result of the systemic poisoning. Treatment was of no avail, although the pain was relieved by wrapping the hands in cotton.

A rare complication, which I do not see noticed in Musser and Norris' recent article,¹ is gangrene of the extremities. A case of this condition was seen by me with Dr. Simcox, to whom I owe the privilege of this report. The patient was a male, aged forty-one years. He was an alcoholic. He was seen November 5, 1906, with a temperature of 103°, pulse 120, and respirations 48,

¹ Osler's Modern Medicine, 1907, vol. iii.

with complete consolidation of the right lung. Contrary to expectation, resolution of the lung occurred, and on November 8 the temperature was normal. It remained normal until November 10, when it suddenly rose to 103.2°. On November 11 the following note was made: There is very marked œdema of both hands and cyanosis of the tips of the fingers of both hands. There is no cyanosis of the lips. There is also cyanosis of the lower half of both forearms, with true petechiæ along the lines of the superficial veins. In the afternoon of the same day the fingers were black and almost gangrenous. The toes were normal.

On November 12, 1906, this note was made: The tips of the fingers are black, cold, and shrivelled to the first joint. The rest of the hand is swollen, warm, and mottled. The gangrene advanced, and the patient died on November 13. The temperature was high until death.

The following is the postmortem note: From the middle of the forearm downward there is a bluish-black discoloration. The tips of the fingers are black, shrivelled, and dry. The radial artery, the ulna, both palmar arches, and two interossii with their digital branches were removed. The arteries are not atheromatous. There is a firm thrombosis filling the interossii to a distance one inch proximal to the digital division, and completely filling the digital branches. Apparently the thrombosis began in the terminal arteries and had advanced upward.

Meningitis may be the result of general poisoning, or it may be the direct result of a local ear condition. As an instance of the former may be cited the case of a lad, aged four years, who was admitted to St. Timothy's Hospital suffering from supposed typhoid fever. There were marked symptoms of meningitis, stiff neck, Kernig's sign, and a *tache*. A lumbar puncture was made and a slightly turbid fluid withdrawn. A diplococcus lying outside of the rather numerous polymorphonuclear cells was demonstrated. Examination later showed areas of consolidation throughout the lungs. The child died, and at the autopsy a meningitis and a consolidated lung were found. Pneumococci were found in the meninges and in the lung. In this case the meningitis was doubtless the initial effect of the pneumococcus.

A second case was also seen in St. Timothy's Hospital: The patient, aged fifty-three years, was admitted February 16, 1908, in the first twenty-four hours of what proved to be a most serious attack. The lung involvement began at the right base, but rapidly involved the whole right lung. The fever never went above 103°, and reached that point but once. The entire temperature range was low. Resolution occurred, delirium disappeared, and the patient seemed about to recover. Gradually, however, she became dull mentally, and on March 3 it was difficult to arouse her. On March 5 the neck was stiff. There was a seropurulent discharge from

the left ear. On March 6 there was distinct retraction of the head, together with dilatation of the left pupil. Eye-ground examination was negative. A spinal puncture was done with the hope of giving relief, but the patient died on March 6, with a sudden rise of temperature to 104°. The temperature had remained practically normal until the morning of March 5.

Pleuritis. By far the most common serious complications of pneumonia in my personal experience are pleurisy with effusion and empyema. Both of these conditions can surely be diagnosticated, if care is taken in comparing the symptoms with the physical signs. Nothing is more distressing than the discovery of an empyema days or weeks after an attack of pneumonia. The condition is constantly diagnosticated unresolved pneumonia, typhoid fever, malaria, etc. The mistake in diagnosis is usually due to the fact that the physician in charge has failed to strip his patient and simply look at the chest. In walking the ward of Johns Hopkins Hospital in company with other physicians, and under the charge of Osler, the following occurred: Osler came to a bed containing a child who had just been admitted, and whom he had never seen before. He threw back the bedcovers and revealed a girl about seven years old, emaciated in the extreme, the left chest bulging, and the cardiac impulse in the region of the right nipple. Osler remarked: "Gentlemen, if you treat your cases like this, at the last day St. Peter will confront you with a line of little children who will point their fingers at you and exclaim, 'You sent us here before our time because you did not take the trouble to examine our chests.'"

Every case of pneumonia should receive a careful physical examination after the crisis, to be repeated until a diagnosis is made, if the patient is not doing well. There is no possible excuse for failure to make those repeated examinations, although a diagnosis may be difficult. The following cases well illustrate my point:

L. J., aged eleven years, was sent to me from Tamaqua, with a diagnosis of appendicitis. His temperature was 102°. His attack had begun two days before with sharp pain referred to McBurney's point. On examination, March 3, the belly was flat, there was slightly more resistance on the right side. There was no tenderness. There was decided dulness over the lower lobe of the right lung. There was blowing breathing at this situation. On March 9 the breath sounds became much less marked and the cardiac dulness was well beyond the nipple line. Signs of effusion over the consolidated area gradually increased. On the 13th the temperature was normal, and remained about 99° until recovery. On the 14th the whole right chest was flat; there was no blowing breathing. The patient was tapped and about six ounces of serum was removed. The patient left the house well on March 25.

A second case, which shows the difficulty of locating the purulent material, is the following:

L. C., aged sixteen years, was admitted October 27, 1900. His temperature remained 103° for five days. It then dropped to normal and remained there for three days. On November 11 he began to have a slightly irregular fever. The fever gradually increased. On December 2 the breath sounds were much less marked over the consolidated area. A needle was inserted and run in all directions, but failed to show the presence of pus. So certain were we by this time that there was a collection of pus in the chest that the patient was urged to undergo surgical exploration of the chest. This he refused. On December 18, after going to his home, he had a severe coughing spell and expectorated a very large quantity of pus. Fortunately, the cavity did not refill, and the patient entirely recovered.

A third case of interest is still in the surgical wards: Geo. Mc., aged eighteen years, was admitted March 14, with consolidation of the lower lobe of the right lung. This very rapidly increased until the whole lung was involved. He was very seriously ill, but on March 22, the temperature reached normal by lysis. It remained normal until April 9, when it began to oscillate. Careful examination showed the whole right chest filled with subcrepitant rales. On the left side, the lung which was not affected by the pneumonia, there was dulness over the entire base on a line horizontal to the nipple. There was no tactile fremitus and no breath sounds nor voice sounds. A needle inserted showed a collection of pus. Resection of the rib was done, and the patient is now about well.

The lesson to be learned from these cases is: Make a careful physical examination during and after the attack. If the temperature does not soon reach normal and remain there, daily examination should be made to search for areas of dulness. When an area is found which is thought to indicate the presence of pus, a large, long needle should be inserted. If pus is found, of course, rib resection must be made. In cases in which the physical signs and symptoms warrant the diagnosis of a collection of pus, and the needle does not show its presence, I feel that an exploration of the chest by a surgeon is not only justifiable but mandatory. It is waste of time and dangerous to play with drugs under these circumstances.

All the cases cited show the necessity of eternal vigilance on the part of the physician, and the necessity of employing modern methods of diagnosis and treatment.

INFLUENZAL MENINGITIS.

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SINCE the discovery, in 1892, by Pfeiffer, of *Bacillus influenzae*, there has existed in the minds of many bacteriologists some doubt as to the specificity of the organism. Contrary to the original observations of the discoverer, the bacillus could be found in inter-epidemic periods without an associated influenza. Moreover, it did not seem possible to reproduce the disease experimentally in animals. The fact that in the meningeal type of influenza, usually a fatal disease, a pure culture of the bacillus can be obtained from the spinal fluid, which, when injected into the meninges of animals, will produce an acute meningitis, affords, perhaps, the best confirmatory evidence we have of the pathogenicity of the organism. Meningitis, due to the influenza bacillus, while at present regarded as a rare manifestation of influenza, will doubtless, with more careful bacteriological study of the cerebrospinal fluid, in the future prove to be a much more common affection than present statistics indicate. The case here reported is of interest on account of its occurrence in an adult and of the termination in recovery.

D. R., a male, aged thirty-three years, was admitted to the service of Professor Barker in the Johns Hopkins Hospital, June 15, 1907, showing signs of meningeal irritation. The personal history of the patient was unimportant except for an injury, two weeks previously, caused by a blow from a bottle above the left ear, following which the patient had remained in bed complaining only of dizziness and cold in the head.

On admission the patient was found to be extremely restless and at times delirious. The neck was held stiffly, with some retraction, and when flexion was attempted the patient raised the whole body in defense. There was a very marked Kernig sign present on both sides. Both eyes were kept closed and the right eye showed a slight external strabismus. The pupils were small and equal, and reacted actively to light. There was no evidence of an acute rhinitis. A crop of herpes was noted at the right commissure of the mouth. An incised wound was found above left ear, evidently only a scalp wound. The heart and lungs were found normal. The spleen was not enlarged. The knee-jerks were active, and plantar stimulation yielded plantar flexion of the great toes. The aural examination gave evidence of chronic middle-ear catarrh of both ears. The ophthalmoscopic examination showed both disks to be very hyperemic, edematous, and slightly swollen. The arteries and veins were large and the veins quite tortuous. In the upper part of the right disk the remains of a small hemorrhage was seen.

Lumbar puncture was performed on the day of admission. The fluid obtained was very slightly turbid and yielded a pressure of 400 mm. Hg. After the removal of about 30 c.c. the pressure equalled 150 mm. Hg. Two subsequent punctures were made, from both of which a turbid fluid was obtained under increased pressure.

The temperature on admission was 101.5°. For about eight days a fastigium of 100° to 104° was maintained. The pulse at this time, in contrast, was slow, from 64 to 95 to the minute. The temperature and pulse chart simulated closely that of typhoid fever. During the second week the morning remissions of temperature became more pronounced, with an evening elevation of 3° or 4°. On the fifteenth day after admission the temperature fell to normal and remained so except for a sharp rise to 104.5° after three days of normal temperature. The temperature following this elevation quickly fell to normal and remained so. The pulse rate was slow throughout the entire course of the disease, at times being only 50 to the minute. The blood pressure remained slightly below normal during the course of the disease, averaging 108 mm. Hg. The respirations on admission were 24 to the minute, never rising above this. They fell gradually after four days and remained at 18 to 20 to the minute.

The erythrocytes showed a fairly high count, 5,304,000 per c.mm. The hemoglobin measured 105 per cent. (Sahli). The leukocytes on admission were on the upper limit of normal, 9800 per c.mm. Four days later they had risen to 13,000. Another count made still four days later showed 13,120 with the following differential findings: Polymorphonuclears, 87.5 per cent.; small mononuclears, 9 per cent.; large mononuclears, 3 per cent.; and eosinophiles, 0.5 per cent. Toward the end of the disease, as the temperature reached normal, there was a fall in the leukocyte count. On July 18, the day on which the temperature fell to normal, the leukocytes were 10,760. After six days of normal temperature the leukocyte count was normal at 8060.

During the first four days there was retention of urine and catheterization was necessary. On admission the urine was high colored, had a specific gravity of 1027, was acid in reaction, and contained a heavy cloud of albumin. Microscopically a few hyaline and granular casts and cylindroids were found. Two weeks later a faint trace of albumin still persisted, but the casts had disappeared. Before the patient left the hospital both albumin and casts were absent. Convalescence was rapid and complete, and the patient was discharged well on the thirty-fourth day.

Bacteriological Report. The cerebrospinal fluid obtained from the first lumbar puncture was very slightly turbid, containing a few flocculi. Smears made from the centrifugalized fluid and stained with methylene blue showed many polymorphonuclear cells and a very few diplobacilli, sometimes only two in a field; some of these

were extracellular, while a few were seen enclosed within the polymorphonuclear cells. The organisms were best stained by a dilute (1 to 10) aqueous solution of carbol-fuchsin. Cultures were made on blood agar, plain agar, glycerin agar, blood serum, and other laboratory media. After forty-eight hours on blood agar, along the streak of the needle, could be seen a delicate growth of small pin-point colonies of dew-drop appearance. The colonies were non-hemolyzing and showed a tendency to remain discrete. The other media remained sterile. Transfers to pigeon-blood agar gave a luxuriant growth of dew-drop colonies, while sub-cultures on hemoglobin-free media yielded no growth. Morphologically the growth showed a short, thick bacillus, resembling a diplobacillus, which was non-motile and Gram-negative, and stained best with dilute carbol-fuchsin and well with Bismarck brown. The culture, which was a pure one, conformed in every respect biologically and morphologically with the bacillus of Pfeiffer.

The same bacillus was also obtained in the fluid from the second lumbar puncture. In the smears from the third puncture it was noted that there were more intracellular organisms, and fewer extracellular than formerly. A pure culture of influenza bacillus was again grown from the fluid of the third puncture.

Two blood cultures were made: one on the day of admission, and a second eight days later. Ten cubic centimeters of blood, taken from the median vein was divided among six agar plates. Both cultures yielded negative results.

The agglutinating power of the patient's serum for the organism obtained from the spinal fluid was tested. A suspension of the bacilli grown upon pigeon-blood agar was used with 1 to 10 dilution of serum. There was some clumping at the end of an hour; there was clumping also with higher dilutions, but the extent of this clumping was not appreciably greater than that found in the controls used. It could not be shown that the serum possessed specific agglutinins. Animal inoculation was also without result. The infection could not be reproduced with repeated injections of an emulsion of the bacilli into the ear veins of a rabbit.

HISTORICAL. The number of cases of influenzal meningitis reported in the literature, in which a precise diagnosis has been made from exact bacteriological findings, is extremely small in comparison with the epidemic character of influenzal infection. I have been able to collect twenty-four cases in which the bacteriological reports may fairly be regarded as trustworthy. Many cases have been reported in which the proof of the identity of the organisms has not been convincing. As early as 1892, following the pandemic of 1899 to 1900 and the discovery of the influenzal organism by Pfeiffer, Pfuhl¹ described three cases of meningitis in

¹ Deut. med. Woch., 1895, Nr. 25; Berl. klin. Woch., 1892, xxix, 979; Deut. med. Woch., 1896, xxii.

which he regarded the influenza bacillus as the etiological factor. Later the same author added eleven additional cases to the literature. All of his cases, however, showed a mixed infection or uncertain bacteriological findings, and cannot be accepted as positive cases of influenzal meningitis.

Haedke,² in 1897, reported a case of purulent meningitis from which, at autopsy, the influenza bacillus was grown along with some putrefactive bacilli, regarded by the author as due to postmortem infection. Fraenkel³ a year later added two cases, both of which occurred in infants. At autopsy in each case a pure culture of the influenza bacillus was obtained from the meningeal exudate. To Slawyk⁴ is due the credit of having first established an exact diagnosis intra vitam of an influenzal meningitis by means of lumbar puncture. Prior to him Testivin⁵ had performed lumbar puncture upon a patient with Pott's disease, who developed meningeal symptoms, and reported the finding of influenza bacilli, regarding the case as one of influenzal meningitis. The report, however, must be accepted with doubt. A case reported by Langer⁶ is of interest as being the first recorded in which recovery has followed an attack of influenzal meningitis. Following these earlier observes, Meunier,⁷ Ghon,⁸ Trailescu,⁹ Dubois,¹⁰ Thomesco and Gracoski,¹¹ M. Simon,¹² and Caccia,¹³ have each contributed cases to the literature. In 1903 Mya¹⁴ reported no less than four well-authenticated cases of influenzal meningitis, all of which occurred in infants. The author in his report expressed the opinion that the influenza bacillus is equally important with the meningococcus or the pneumococcus as the casual agent of meningitis in infants. In the year following Bertini¹⁵ and Jundell¹⁶ reported one and two cases respectively. Dudgeon and Adnas¹⁷ have observed a case of pyemia, which they regarded as due to the influenza bacillus and in which there was an associated multiple arthritis and meningitis. The primary focus was believed to be an epiphysitis of the upper end of the radius. The author stated that a pure culture of *Bacillus influenzae* was obtained in the pus from the elbow, from the spinal fluid, from an abscess about the hip-joint, and from the splenic juice. Douglas¹⁸ in the same year (1907) reported a case which he cites as the first case observed in England in which the organism was obtained in pure culture from the cerebrospinal fluid during life, and from the meningeal exudate at autopsy. Adams,¹⁹ also during the same year,

² Münch. med. Woch., 1897, xlv, 806.

⁴ Ibid., 1899, xxxii.

⁶ Jahrb. f. Kinderheilk., 1901, liii, 91.

⁸ Wien. klin. Woch., 1902, xv, 667.

¹⁰ Thèse de Paris, 1902.

¹² Cited by Dubois, Thèse de Paris, 1902.

¹⁴ Gaz. degli osped., 1903, xxiv, 269. Riv. di clin. pediatrica, Firenze, 1903, i, 465.

¹⁵ Riv. di clin. pediatrica, Firenze, 1904, ii, 673. ¹⁶ Jahrb. f. Kinderheilk., 1904, lix, 777.

¹⁷ Lancet, 1907, clxxiii, 4384.

¹⁹ Archives of Pediatrics, New York, 1907, xxiv, 721.

³ Ztschr. f. Hyg., 1898, xxvii, 315.

⁵ Dauphiné medical., 1897, xxii, 49.

⁷ Compt.-rend. d. soc. de biologie, 1900, 5.

⁹ Ref. in Münch. med. Woch., 1902, 118.

¹¹ Abs. in Révue neurologique, 1905, 44.

¹³ La Pediatria, 1903, 172.

reported a case which he stated to be the first recorded in America, in which the clinical diagnosis of influenzal meningitis was confirmed by the finding of the Pfeiffer bacillus in the spinal fluid. A second case reported by Spriggs,²⁰ was believed to be due to the influenza bacillus. In France during the same year Carles²¹ reported an additional case.

A number of observers have published reports of cases of influenzal meningitis in which the *Bacillus influenzae*, carefully identified, has been found associated with some other microörganism in the spinal fluid *intra vitam*, or in the meningeal exudate at autopsy. With such mixed infection it is impossible to state which is the dominant organism, and the cases cannot be regarded as of purely influenzal etiology. Such reports have been made by Peucker,²² Högerstedt,²³ Nuttall and Hunter,²⁴ Hecht,²⁵ Ghon,²⁶ and G. L. Simon.²⁷

In a third group must be placed a number of cases reported in the literature as influenzal meningitis, in which the bacteriological studies have been incomplete, or of such a nature as to leave doubt concerning the identity of the organism. The reports of Cormil and Durante,²⁸ Gioelli and Zirolia,²⁹ Bury,³⁰ Rendu³¹ and Carlini³² are of this nature. In still another class may be mentioned the reports of influenzal meningitis in which the diagnosis has been made wholly upon clinical evidence. Since a precise diagnosis is possible only by the bacteriological examination of the spinal fluid, such reports are obviously worthless in a statistical study of the disease.

PATHOLOGICAL ANATOMY. The greater number of the cases of influenzal meningitis reported in the literature have come to autopsy. The pathological lesions found have been of a nature similar to those of meningitis due to the meningococcus and pneumococcus. So faithful has been the resemblance that such good observers as Fraenkel and Ghon have believed it impossible to distinguish, either macroscopically or microscopically, meningitis of influenzal origin from the meningococcal or pneumococcal forms.

One interesting condition found in this form of meningitis is the extreme variability in the localization of the lesions, dependent in some measure upon the portal of entry of the invading organism. The dura mater may be found infiltrated throughout its entire extent, forming a diffuse meningitis, as in the case of Meunier. In other cases the involvement is not uniform, and distinct zones may be found free from the purulent exudate. In such areas the dura is firm and brilliant. Where the dura has been covered with pus, it

²⁰ Amer. Jour. Obstet., 1907, lvi, 467.

²² Prager. med. Woch., 1901, xxvi, 153.

²⁴ Lancet, London, June 1901, p. 1524.

²⁶ Wien. klin. Woch., xv, 1902, 667.

²⁸ Bull. de l'academie de médecine, 1895, 469.

²⁹ Cited in Centralblatt, f. path. Anat., 1901.

³⁰ Brit. Med. Jour., 1900, ii, 877.

³¹ Bull. et men. de la soc. med. des hôp. de Paris, 1901.

³² Riv. di clin. pediatrica, 1907, v. 42.

²¹ Jour. de med. de Bordeaux, 1907, 106.

²³ St. Petersburg med. Woch., 1895.

²⁵ Jahrb. f. Kinderheilk., 1903, lvii, 333.

²⁷ Rev. mens. de mal de l'enf., 1905, xxiii, 271.

is thickened and opaque. Microscopically an enormous infiltration of the tissue is found. The appearance of the pia mater is similar, being found almost normal in certain areas, where a deposit of pus has not taken place. In the regions where the pus is abundant the pia has a dull aspect and the vessels are much congested.

The surface of the brain is usually flattened, especially over the areas where the purulent exudate is most abundant. The lesion may be greater at the base of the brain where the cerebrospinal fluid is most abundant, as in the cases of Fraenkel, Haedke, Slawyk, and Ghon. In a second case reported by Fraenkel the lesion was most prominent over the posterior extremity of the right hemisphere. The inferior surface of the frontal lobe was found attacked, in an observation made by Haedke. The lesion, again, may be almost unilateral. In one of Ghon's cases a fibrinopurulent leptomeningitis of the right cerebral hemisphere was found. The convolutions in the affected areas may be so thickly covered with the exudate as to efface the sulci and fissures. The deposition of pus is usually greatest along the course of the vessels. The ventricles, as a rule, are dilated and filled with a serous or seropurulent fluid, sometimes reaching a purulent condition, as in the observations by Fraenkel and Slawyk. An acute hydrocephalus is not uncommon. The tela choroidea was found infiltrated with pus in the cases reported by Bertini and Douglas. The cortex and medulla may be found without change. Small focal hemorrhages are not uncommon. The gray matter was found softened in the case of Douglas.

The pathological picture is more uniform in regard to the findings in the cord. A diffuse meningitis, with lesions predominating over the dorsal surface of the cord, is the rule. The cord itself usually escapes, although in some cases a myelitis has been found. The anterior surface of the cord may be found free from inflammatory exudate (Douglas).

The exudate presents varying aspects. In general it is thin, of a greenish-yellow color, and of gelatinous consistence; at times it may be simply serous. The deposition is more or less uniform and is increased along the course of the vessels. It is found most abundant upon the inferior surface of the brain, and over the dorsum of the cord, a condition not improbably due to the decubitus of the patient. The pus, as a rule, is inodorous, although a fetid condition has been described.

The cerebrospinal fluid is usually turbid. At times, however, it may be so clear and transparent as to suggest a meningitis of tuberculous origin. In other cases it is purulent. The sediment is invariably rich in polymorphonuclear cells. In our case 1306 cells per c.mm. were found, of which about 76 per cent. were polymorphonuclears. The fluid is always under increased tension. A pressure of 400 mm. was noted in our case at the first lumbar puncture; 280 mm. at the second, and 250 mm. at the third puncture. In

Slawyk's case the pressure measured 450 mm. The protein content is also increased, being 1 per cent. in Bertini's case. In Bury's case the sodium chloride content was estimated at 0.78 per cent. and the freezing point of the fluid was found to be -0.75° . Slawyk determined the toxicity of the fluid, and found 0.5 c.mm. to be lethal for a guinea-pig in thirty minutes.

The occurrence of the bacilli in the pathological lesions has been variously described. Fraenkel maintained that the causal agent is found only in the exudate, and is without any relation to the meninges and cerebral tissue. Pfuhl states that the bacilli are found disseminated throughout the neuroglia, in the lymph channels, in the interstitial cellular tissue, and in the blood capillaries. In Slawyk's case the bacilli were found generally distributed throughout the whole body: in the fluid of the left ventricle, in the blood, in the lungs, even in the smallest bronchi and alveoli, but not in the nasal secretion. The heart is usually found normal. There may be cloudy swelling of the heart muscle; at other times a dilated heart. Cloudy swelling of the liver and kidneys is commonly found. The lungs may be normal, or present the lesion of an acute bronchitis, or broncho-pneumonia. Pleuritis has been found. Empyema of the frontal sinuses and the maxillary antrum and, more frequently, otitis media have been described.

BACTERIOLOGY. Since the influenzal nature of a meningitis can be demonstrated only by the identification of the influenza bacillus in the cerebrospinal fluid, a careful bacteriological study of a suspected case is of primary importance. The bacilli can be found in the fluid *intra vitam*, by means of lumbar puncture, or in the meningeal exudate at autopsy. The recognition of the organism is by no means easy. The spinal fluid may appear quite normal, and unless careful search be made the bacilli may be overlooked in smears. It is for this reason important that routine cultures from the spinal fluid be made on hemoglobin-containing media in all suspected cases, since otherwise, with ordinary media, the cultures may be reported as sterile.

The bacilli were first found in the cerebrospinal fluid during life by Slawyk; following him a number of other observers have obtained pure cultures of the bacillus in cases of influenzal meningitis. Cultures of the bacillus, mixed with other microorganisms, have been obtained by several observers. At autopsy the bacilli have been grown from the pus of the meningeal exudate, from the ventricular fluid, and from other parts of the body in cases in which a general infection was associated with the meningitis. Dudgeon has reported the growth of a pure culture of influenza bacilli from the pus of an epiphysitis involving the elbow, from an abscess about the hip, and from the splenic juice.

Pfeiffer found that the bacilli grew best upon pigeon-blood agar, a fact which he regarded as due to the instability of the pigeon

corpuscles, which allowed the hemoglobin to diffuse more readily into the media. Cantani³³ demonstrated that the bacilli will grow symbiotically upon spermatic fluid, and many other hemoglobin-free media, and hence regarded the globulin as the constituent favoring growth. Ghon, however, has shown that the media which Cantani used is not entirely free of hemoglobin. Davis³⁴ was able to grow influenza bacilli on media containing an infinitesimally small amount of hemoglobin, as little as 1 part in 180,000. The bacilli apparently multiply favorably in the cerebrospinal fluid.

In the smears made from the centrifugalized fluid in a case of influenzal meningitis, the bacilli may be numerous, or only a few may be seen in each field, occurring as short small rods with rounded ends. The length is about two or three times that of the breadth, usually 0.2 to 0.3 μ by 0.5 μ . They stain best with dilute (1 to 10) watery carbol-fuchsin. They may be found intracellular or extracellular, and are Gram-negative. At times prolonged search of a smear may be necessary to reveal their presence.

The culture on blood agar after twenty-four to forty-eight hours shows a delicate growth along the streak of inoculation of small, non-hemolyzing, dew-drop colonies, pin-point in size. The colonies tend to remain discrete, are oval or circular in outline, and have no central nucleus. They grow best at 36° to 38° C. Transfers may be grown on hemoglobin-containing media, but sub-cultures on ordinary media remain sterile.

PATHOGENESIS. There has been considerable experimental work done by various observers which seems to show that the cerebrospinal fluid affords an excellent nutrient medium for the growth of the influenza bacillus, and that the central nervous system is to be regarded as a locus minoris resistentiæ for the organism. Animal experimentation, on the whole, has not met with marked success in so far as the production of a general infection with the organism is concerned. Pfeiffer, himself, in a series of many experiments on mice, rats, guinea-pigs, rabbits, hogs, cats, dogs, and monkeys was unable to cause a true infection. In apes alone could an infections process be induced. In the other animals death could be produced only through the toxin. Jacobson found that an increase in virulence resulted when the influenza bacilli were injected into animals along with a culture of streptococcus. Many other observers have attempted to produce a general infection in animals, but the results have been almost invariably unsuccessful.

Cantani attacked the problem of infection in a new way, believing that in order to insure results the infectious agent should be transferred directly to the site of the organ to be studied. He experimented at great length upon the action of the bacilli in the central nervous system. After demonstrating that the role of trauma, due to the introduction of a foreign substance into the cavum cranii is

³³ Ztschr. f. Hyg., 1896, xxiii.

³⁴ Jour. Infec. Dis., 1907, xxiv, 73.

an insignificant one, be injected cultures of the influenza bacillus into the brain substance directly. With a large dosage in rabbits, the temperature, after eight to ten hours, rose to about 42° C., falling again after twelve to eighteen hours to normal or sub-normal. Dyspnoea with clonic spasms, followed by paralyses beginning in the hind limbs and quickly spreading over the whole body, terminating in death, formed the clinical picture. When the dose was not lethal signs of chronic meningitis soon developed. At autopsy the meninges were found strongly hyperemic, thickened, and cloudy, with a bloody serous exudate. The brain was also hyperemic, and the ventricles contained often a purulent exudate, in which the influenza bacilli were found microscopically and culturally. In microscopic sections the bacilli were found in the brain substance, and appeared to spread through the lymph vessels, being found in the lymph capillaries. In the cord the bacilli could be traced as far as the cauda equina, and they appeared to spread from the central canal into the gray matter. He concluded that the brain of the rabbit is a good nutrient substratum for the growth of the influenza bacillus.

His work with the toxins of the influenza bacillus was none the less interesting. Prior to him Pfeiffer had shown the toxin to be an intracellular one, bound up in the cell life. Cantani demonstrated that this endotoxin is in the highest degree toxic for the central nervous system, and that from 2 to 6 mg. of the dead bacteria is sufficient to kill an animal of 1500 to 2000 grams. He found experimentally that the action of the toxin of the influenza bacillus upon the central nervous system, as compared with toxins of other bacteria, is extraordinarily great. The inoculation of 12 mg. of a killed culture of cholera vibrio, 6 mg. of *Bacillus coli communis*, 6 mg. of *Bacillus pyocyaneus*, 9 mg. of *Bacillus typhosus*, or 9 mg. of *Staphylococcus aureus* in various animals caused no marked symptoms, while a dosage of 6 mg. of influenza bacillus was lethal.

Slatineano³⁵ was able to extract from cultures of influenza bacilli what he believed to be an endotoxin which was lethal for guinea-pigs upon injection into the brain substance, but had little action when injected into the peritoneum, showing the greater susceptibility of the central nervous system.

It has not as yet been certainly demonstrated that the serum of an infected patient contains agglutinins for the influenza bacilli. Cantani claims to have found that the agglutinating power of the serum of an immunized animal may be present up to a dilution of 1 to 500. Lord³⁶ in a series of such experiments found that the necessary dilution was low, that the reaction was very inconstant, and that the serum of apparently uninfected individuals also produced clumping. A positive agglutination reaction could not be obtained with the serum of our patient.

³⁵ Compt.-rend. d. soc. de biologie, lix, 339. ³⁶ Osler's Modern Medicine, vol. ii, p. 469.

The question of the portal of entry of the influenza bacilli into the central nervous system has been the subject of much interesting discussion. By far the most common type of influenza is the respiratory one, characterized by acute rhinitis and bronchitis. This fact suggests the nasopharynx as a probable portal of entry. Fraenkel is an advocate of the hypothesis that the bacilli are conveyed from the lymphatics of the nasal fossæ, which in turn communicate with those of the meninges through the cribriform plate of the ethmoid, spreading thence directly into the cavum cranii. The theory is plausible, but at autopsies in almost all the cases of influenzal meningitis, the nasal fossæ have been found for the most part normal, and only rarely could a culture of influenza bacilli be grown from the nasal secretion.

The middle ear is also a likely portal of entry, especially when one considers the frequency with which otitis media develops as a complication or sequel of influenza, and how commonly influenza bacilli have been found in the pus of otitis media. At the Otological Congress in Bonn, in 1894, Hartman and Konel stated that they had found influenza bacilli in 90 per cent. of the cases of otitis media of influenzal origin in infants. Cheatle³⁷ believes that meningitis may be produced by infection from the middle ear, being carried along the vessels which pass through the remains of the petrosquamosal suture from the antrum to the middle fossa, without direct extension of caries. Posteriorly a middle-ear abscess may perforate through the bony portion which separates the mastoid cells from the lateral sinus, giving rise to an extra dural abscess in the posterior fossa, and it may thence extend farther, causing meningitis, thrombosis of the lateral sinus, or cerebellar abscess.

A general infection with the influenza bacillus must also be considered as a possibility in the production of meningitis. Several observers have been able to grow the bacillus from the circulating blood, and a multiple localization of the infection is conceivable. Slawyk regarded his case as one of general infection.

The primary foci of infection in the cases reported in the literature have been diverse. Ghon found a frontal sinus infection as the probable primary focus. The case reported by Headke was secondary to an otitis media, and influenza bacilli were found in the middle-ear pus. In Hecht's case the onset was preceded by an influenzal pneumonia of the right upper and lower lobe. Fraenkel believed acute rhinitis and bronchitis to be primary in his case. In the case reported by Dudgeon and Adams the primary lesion was thought to be an epiphysitis of the upper extremity of the radius, in the pus of which influenza bacillus were found. Bertini considered that the meningitis should be regarded as a multiple localization of the infection, since in his case it was uncertain whether the pneu-

³⁷ Practitioner, 1907, lxxviii, 104.

monia or the meningitis was primary. In Slawyk's case a general infection was found. In a case reported by Mya the lung was thought to be the primary focus, with the occurrence of metastatic foci in a hematoma of the scalp, and an extension of the infection to the meninges through a fracture of the skull. In my case chronic otitis media, along with trauma, was probably the causative agent. The other observers have expressed no opinion in regard to the portal of entry.

AGE AND SEX. The disease greatly predominates among infants and young children. Adults would seem to possess an immunity. Of the cases reported in which the age was noted, 14 (56 per cent.) were under one year of age, 8 between one and ten years, 2 in the second decade, and but 1 beyond this age. Males have been attacked more frequently than females in the cases reported, in which the sex was stated, in the proportion of 16 to 6.

SYMPTOMATOLOGY. The onset of an influenzal meningitis may be sudden without prodromal symptoms, beginning with a chill, high fever, and marked cephalic disturbance. When the base of the brain is first attacked the clinical pictures closely simulates the epidemic type of cerebrospinal meningitis. More frequently the vertex is first involved, giving rise to intense headache without retraction of the head.

In the majority of cases the disease is ushered in with the syndrome of the respiratory type of influenza, headache, rhinitis, bronchitis, general malaise, and fever. Gradually the meningeal symptoms predominate. In infants the onset may be characterized by cough, fever, loss of appetite, and diarrhœa. It is usually impossible to state at what time the involvement of the meninges has taken place. Fraenkel lays stress upon the cramps in the calves of the legs as indicative of a disturbance of the central nervous system. The period of incubation is unknown.

During the initial stage the symptoms differ according to the age and resistance of the patient. The adult complains of severe headache, and of pain in the back of the neck. There may be pain along the entire length of the spine. The patient is usually rational. In infants an early delirium, with marked motor agitation, and extreme prostration is common, and there may be an associated gastrointestinal disturbance with nausea, vomiting, and diarrhœa. The meningeal symptoms quickly become more pronounced. The head is held retracted by the posterior cervical muscles, and passive movement is painful. If the lesion involves the base of the brain the head may be turned toward the right or left, or paralysis of the facial muscles may result. The child may have convulsive seizures, either general or localized in certain groups of muscles. Muscular tremors in the extremities are common. There is usually marked general muscular rigidity, and the patient lies with the legs flexed on the thighs. A positive Kernig's sign has been present in the majority

of cases reported. The ocular muscles are usually involved, although the eye symptoms are variable. Most frequently there is pupillary dilatation, and strabismus. The pupils may be unequal; they react poorly to light and better to accommodation. The fundi are negative in the majority of cases, although an optic neuritis has been noted in several instances. In our case the disks were found hyperemic and œdematous. Photophobia has been observed. Cutaneous symptoms are not uncommon. A general hyperesthesia may be present. Herpes labialis occurs, but less frequently than in the epidemic form of meningitis. The fever gradually rises to 101° to 104° , and maintains a fastigium; later, in favorable cases, an amphibolous character may develop with morning remissions to normal, and an evening rise of from 2° to 3° . In fatal cases, toward the end, the temperature may become subnormal. A sharp rise of several degrees is not uncommon at any stage of the disease. The pulse rate in infants may be rapid, but bradycardia is not uncommon. In my case the pulse rate never rose above 95, the average rate being 70 to 80 to the minute. On several occasions it was found to be as low as 50. In fatal cases, in the terminal stage, the pulse may become small, rapid, and irregular, with failing circulation. The heart has been found normal on auscultation in all of the observations. The respirations are but slightly affected in the majority of cases. The rate may be somewhat increased. In my case the respirations remained practically normal throughout the course of the disease. In fatal, or severe, cases dyspnœa, at times of Cheyne-Stokes character, has been observed. In the lungs in many cases diffuse rales and patches of bronchopneumonia have been found.

The abdomen is usually found normal, but may be scaphoid, as in the observation of Haedke. Distention and tympanites have been noted. The spleen is sometimes enlarged; more frequently not. Gastro-intestinal symptoms are common, especially nausea and vomiting. Diarrhœa occurs frequently in children. In my case constipation was a marked feature.

The reflexes are variable, sometimes being found normal and at other times exaggerated. The knee kicks and cremasteric reflex was reported as increased in Bertini's case. A positive Babinsky's sign has been found present in the majority of the cases. The abdominal and epigastric reflexes may be absent. Psychic symptoms are usually present and are especially pronounced in children. In adults periods of lucidity alternate with an irrational state. Delirium is common and persistent in young children, and there may be marked motor agitation.

After a few days the symptoms of excitation usually give way to those of depression, and paralysis of various groups of muscles is not uncommon. Macular atrophy and emaciation may be progressive. In fatal cases the patient falls into a state of collapse

with shallow respirations, sometimes showing a Cheyne-Stokes character, the skin becomes clammy, the pulse thready, or imperceptible, and the sphincters relaxed. A subnormal temperature and comatose condition usually precede the fatal issue. In cases in which recovery takes place the improvement is gradual. Convalescence, when once established, is usually rapid and may be complete. In but one of the four cases reported, in which recovery has taken place, was any residue noted: left-sided facial paralysis and a partial right-sided hemiplegia, persisted in a child.

The duration of the disease was usually short. In the fatal cases reported death resulted as early as thirty-six hours, and as late as one month from the onset, the average duration being eleven days. In the cases which have recovered, the illness lasted from eleven days to six weeks.

The blood picture in influenzal meningitis has received insufficient study for any trustworthy conclusions. A slight grade of leukocytosis (13,000) was present in my case, and a differential count showed the polymorphonuclear elements to be somewhat increased. In Adam's case the leukocytes were found to be 10,000 per c.mm.

The urine frequently shows pathological changes. The daily output may be decreased. Retention of urine is commonly encountered. Albuminuria may be present, but is not the rule. A diazo reaction has been noted in some cases.

The complications associated with an influenzal meningitis are many and varied, and most frequently involve some part of the central nervous system. Encephalitis, myelitis, anteropoliomyelitis, optic neuritis, hemiplegia, paraplegia, epidural abscess, acute hydrocephalus, and different paralyses have all been described. In the lungs, bronchitis, bronchopneumonia, and a fibrinous pleuritis are common.

DIFFERENTIAL DIAGNOSIS. A positive diagnosis of meningitis due to the influenzal bacilli can only be made by means of a lumbar puncture, and the finding of the organism in the cerebrospinal fluid. In the course of an attack of influenza the patient may frequently show signs of meningitis, which may be in part due to the action of the toxins on the central nervous system, or to the hyperemic condition of the meninges. Associated with this condition are signs of meningeal irritation such as intense headache, vomiting, slow pulse, and a stiffness of the cervical muscles. Such cases occur most frequently in children and may present the full clinical picture of meningitis. There is, however, complete recovery in a few days. To this condition Donath³⁸ has given the name of "pseudomeningitis grippalis." Some cases have come to autopsy, and at most a hyperemia of the meninges was found, much like meningitis serosa without microorganisms.

³⁸ Deut. med. Woch., 1902.

It is most difficult, and usually impossible, to distinguish clinically a meningitis of influenzal origin from one due to the meningococcus, or pneumococcus. The symptoms differ according as the vertex or the base of the brain receives the brunt of the attack. Statistics appear to show that the vertex is more frequently affected than the base, and associated with this localization of the process are intense headache, and, but slight, if any, rigidity of the neck muscles. The basal form more closely resembles the epidemic cerebrospinal meningitis. Both may begin with a chill and high fever and stiffness of the neck. In both forms herpes labialis may occur, although usually it is more extensive in the epidemic form. The presence of a preëxisting influenzal attack, with headache, coryza, bronchitis, and fever, or an influenzal pneumonia, makes the diagnosis less difficult. Leichtenstern,³⁹ in an analysis of cases of epidemic cerebrospinal meningitis, was able to show that such prodromal symptoms are rarely if ever present in the epidemic form.

A secondary pneumonia commonly follows an influenzal meningitis, while such a complication is rare in the meningococcal form. The influenzal origin of the pneumonia may be demonstrated by the finding of influenzal bacilli in the sputum. However, since the majority of cases of influenzal meningitis run their course without respiratory symptoms, an examination of the sputum may give negative results. The co-existence of an epidemic of influenza, or the presence in the patient of a primary focus of influenzal infection in the aural or nasal passages, should lead one to suspect an influenzal process in the meninges. Cutaneous lesions are more common in the cerebrospinal fever than in influenzal meningitis. A petechial rash has been observed in only one case of influenzal origin, and purpura in one other. Bertini states that psychic symptoms are less pronounced in the influenzal form than in the pneumococcal or meningococcal meningitis. The leukocytes may prove to be of assistance in establishing a differential diagnosis. A high grade of leukocytosis of from 25,000 to 40,000 is present in the meningococcal form. The study of the leukocytes in influenzal meningitis has received scant attention. In our case the leukocytes never rose above 13,000, while in another case they were found to be 10,000. It seems probable that a low grade of leukocytosis is characteristic of this disease. The routine taking of blood cultures offers another valuable aid in diagnosis. The meningococcus is commonly found in the blood in cases of epidemic cerebrospinal fever. Blood cultures in influenzal meningitis have so far yielded negative results.

The diagnosis of influenzal meningitis from that of tuberculous meningitis presents no great difficulty, except when the patient is seen late in the course of the disease, when a fully developed stadium meningiticum is established. The onset of tuberculous meningitis

³⁹ Nothnagel's Spec. Path. u. Therapie, 1896, iv, 123.

is insidious, with a prodromal period characterized by emaciation, asthenia, digestive disturbances, and gradually developing meningeal symptoms. The initial delirium is also wanting and herpes labialis is most uncommon. The presence of tubercles in the chorioid, if found on ophthalmoscopic examination, indicates a tuberculous origin. In very young children the course of tuberculous meningitis may be almost as rapid as that of the influenzal form. In such doubtful cases lumbar puncture affords the only certain means of diagnosis. A cytological study of the cerebrospinal fluid, in a case of tuberculous meningitis, shows invariably an increase in the lymphocytes, while in an influenzal process there is a polymorphonuclear leukocytosis. The tubercle bacilli can also be found in smears. The fluid in tuberculous meningitis is usually clear, while in the influenzal form a turbid or purulent fluid is commonly found.

PROGNOSIS. The prognosis, as in all forms of infectious meningitis, is extremely grave. In influenzal meningitis the infection involves the meninges throughout almost the entire nervous system, and shows a preference for subjects debilitated and infants. Cases occurring in adults are rare. Moreover, Cantani has shown that the central nervous system is a *locus minoris resistentiæ* for the influenza bacillus. Of the twenty-six cases collected a fatal issue resulted in all but four patients, giving a mortality of 85 per cent. The younger the patient the more grave seems to be the prognosis. Recovery was complete in three of the cases. In the fourth a facial paralysis and partial hemiplegia persisted.

TREATMENT. There is as yet no specific treatment for influenza. The therapeutic indications for influenzal meningitis are those for meningitis in general. The role of lumbar puncture as a therapeutic measure has been much discussed, and the conclusions have been conflicting. For diagnostic purposes lumbar puncture is always indicated. In the majority of the cases the removal of the spinal fluid, which is under increased tension, has been followed by a temporary improvement in the condition of the patient. In Langer's case lumbar puncture was followed by an amelioration of symptoms and a fall in temperature to normal the day following. The child recovered. In Slawyk's case no improvement was noted after puncture except a decrease in tension of the fontanelles. Caccia found that his patient appeared better after puncture. In my case three lumbar punctures were made, following which there was no marked improvement which could be attributed to the removal of the spinal fluid. Even with these apparently conflicting results lumbar puncture seems to afford at present the most rational therapeutic procedure in the treatment of the disease.

ILLUMINATING GAS POISONING.

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CHEMISTRY. The employment of gas manufactured from coal for illuminating purposes is over a century old. The original method was by the destructive distillation of coal or wood in retorts, with subsequent purification. Ammonium and sulphur compounds are the most objectionable impurities of crude gas, and much attention has been given to their removal. The gas-product by this method is principally hydrogen, hydrocarbons, and a very small amount (7 per cent.) carbon monoxide. Toxic qualities of illuminating gas produced in this manner are very low. In recent years the trades, to reduce the cost and simplify the production, have developed new methods of foreing steam through hot coal or coke. The action is not distillation, but oxidation, of coal to carbon monoxide, which is itself reduced by hydrogen. To this "water gas" is added hydrocarbons, that is, methane, ethane, benzene, etc., to fit it for illuminating purposes. The most striking characteristic of "water gas" is its toxicity, due to the excess of carbon monoxide, of which gas it contains 45 per cent., or 38 per cent. more than the carbon monoxide content of coal gas. Carbon monoxide possesses a strong chemical affinity for hemoglobin, with which it combines to form carbon-monoxide-hæmoglobin, resisting decomposition by free oxygen. Hufner states that 1 gram of hemoglobin will take up 1.3 c.c. of carbon monoxide.

CAUSES. The causes of illuminating gas poisoning are:

1. Hygienic: Deficiency of instruction as to its use, defects of construction of apparatus, and deficiency of ventilation.
2. Psychopathic: Insanities, acute and chronic, exciting absorption of illuminating gas into the blood by inhalation.

Hygienic causes necessarily are responsible for those cases of poisoning which are accidental (non-suicidal), and usually result from lack of instruction of those inexperienced in the manipulation of gas-lighting fixtures. Most cases of poisoning by illuminating gas, however, are the result of suicidal premeditation.

OCCURRENCE. The number of cases of illuminating gas poisoning occurring in large cities has been progressively on the increase in the last ten years. This is certainly the reverse of our expectations, and is a medicosociological question worthy of solution. It cannot be attributed to defects of plumbing, as our buildings are more carefully and intelligently inspected by municipal officers today than they were ten years ago. The use of illuminating gas has been diminishing as electricity succeeds it for lighting purposes.

The enormous increase in the number of cases of poisoning by illuminating gas may be attributed to several changes in the conditions of men: (1) Concentration of population in cities, and (2) increased susceptibility to emotional states and insanity. The enactment of rigid laws restricting the sale of toxic drugs to the layman has also had a tendency toward the increase of poisoning by illuminating gas. The following statistics, while somewhat indefinite, are valuable as an indication of the extent of increase of illuminating gas poisoning:

DEATHS FROM POISONOUS GASES IN NEW YORK CITY.

1867-1880 (twelve years)	16
1880-1892 (twelve years)	202
1889	37
1890	54
1891	64
1902	353
1906	419

PHILADELPHIA.

1899	30
1900	19
1901	26
1902	36
1903	45
1906	50

These are deaths known to be suicidal. In 1906 in Philadelphia 74 deaths from inhalation of poisonous gases were reported in addition to the 50 known to be suicidal. In Boston 43 fatal cases were reported in 1904.

City.	Deaths from inhalations of poi- sonous gases, 1906.	Suicides by asphyxia, 1906.
San Francisco, Cal.	35	24
Denver, Col.	2	3
Washington, D. C.	14	12
Atlanta, Ga.	3	1
Chicago, Ill.	126	55
New Orleans, La.	4	1
Baltimore, Md.	14	9
Boston, Mass.	18	10
Kansas City, Mo.	10	2
Buffalo, N.Y.	5	1
New York, N.Y.	250	169
Cincinnati, Ohio.	6	1
Cleveland, Ohio.	6	1
Philadelphia, Pa.	74	50
Pittsburg, Pa.	5	...
Galveston, Tex.	3	...
Norfolk, Va.	3	1
Richmond, Va.	4	...

Comparative studies of these figures from many points of view may be interesting and instructive, but it is not my object to treat of the subject statistically. Having presented the figures, I wish to just-

tify my study of the clinical picture by the progressive increase in death rate. Suffice it to say that in nineteen cities approximately 4000 cases of poisoning from gases, with 582 deaths, have occurred; 340 of the cases were suicidal.

SYMPTOMATOLOGY. The symptoms of gas poisoning are the manifestation of the abolished interchange of oxygen for carbon monoxide in the alveoli of the lungs, and the absence of oxidation of the detritus of cell energy in the body, together with the combination of the constituents of illuminating gases with the physiological elements, changing them into toxic substances. The characteristic features of acute gas narcosis are not constant, and the severity and duration of toxic symptoms depend largely upon the duration of exposure.

Respiratory System. Much has been written of the effect of illuminating gas on the pulmonary system. The respirations are rapid and labored—often of the Cheyne-Stokes type; the face is cyanosed. There is often mouth frothing, the froth frequently containing blood. Most of the fatal cases present, sooner or later, pulmonary oedema as a complication, which is considered the cause of the incident rise in temperature and leukocytosis. I have seen cases in which there was no evidence of pulmonary oedema, with rise in temperature and leukocytosis. W. Gilman Thompson has found oedema, bronchopneumonia, acute congestion, emphysema, pleurisy, and atelectasis at necropsy.

Cardiovascular System. The pulse in all cases is rapid, feeble, and perhaps irregular, being out of all proportion to the temperature and respiration. Examination of the blood shows a most conspicuous change. In a series of cases studied during my incumbency in the Emergency Hospital in 1904 and 1905, I found the red cells reduced 3,000,000 to 1,000,000, and the hemoglobin from 14 per cent. to 69 per cent., the degree of reduction being inversely proportional to the duration of exposure and severity of symptoms. The leukocytes were increased, varying between 9000 and 22,000. Morphologically, the red blood cells showed marked poikilocytosis, granular and hydropic degeneration, polychromatophilia, and enucleation. Polychromatophilia is especially conspicuous, and would seem to confirm Engel's theory, that these cells appear when rapid new formation of red corpuscles is demanded and when there is not time for complete shrinkage of nucleus and development of orthochromatic cells. The color index was minus, and the specific gravity and coagulability increased. Thompson reports an increase in red blood cells, but my study of 15 cases, herewith appended, fails to corroborate his observations except in the early stages (two to six hours), when the red cells and hemoglobin were usually normal or slightly increased. The anemia was, in favorable cases, followed by a return to normal; but in fatal cases the anemia persisted or increased. While there was a marked change in the hemocytic

elements, probably due to effects of carbon monoxide, I am of the opinion that the primary increase in red blood cells and leukocytes is in a large measure due to the transudation of blood serum from the vessel walls into the tissues. The whole blood is increased in specific gravity and coagulability, with the presence of non-inflammatory œdema of the lungs, cutaneous blebs, and often serous leptomeningitis. The polycythemia, if due to a decrease in the volume of the plasma, is only a relative polycythemia, and the concentration of solid elements of the blood only temporary. Much importance was attached to the primary increase in red cells per cubic millimeter during the early stages, and the phenomenal decrease after a few hours. The pronounced secondary anemia occurring within five or six hours after the onset of coma is in a degree due to the fact that most of these cases are submitted to venesection and intravenous transfusion of $\frac{N}{10}$ saline solution, which produces hydremia and low red cell count. The presence of abnormal morphology, with slow return to normal is in favor of hemolytic anemia. The blood pressure is at first increased, but after prolonged exposure rapidly diminishes.

Exposure.	Coma.	Temperature.			Respiration.	Blood findings.			
		Maximum.	Minimum.	Pulse.		Leukocytes.	Red blood corpuscles.	Hemoglobin.	
1. 2 hours	3 hours	100°	98°	112	30	10,000	5,000,000	80%	
2. 3 hours	5 hours	101°	98.4°	118	30	No rep't			
3. 2 hours	1 hour	100°	98.2°	126	28	No rep't			
4. 3 hours	9 hours	100.4°	98°	126	30	12,000	4,600,000	70%	
5. $\frac{1}{2}$ hour	None	99.4°	98°	100	24	9,000	4,000,000	80%	
6. 5 hours	72 hours	108°	100.8°	160	68	18,000	3,000,000	20%	
7. 8 hours	12 hours	105°	96.8°	140	48	No rep't			
8. 3 hours	10 hours	100.8°	98°	120	32	No rep't			
9. 6 hours	24 hours	106.6°	103.2°	140	48	No rep't			
10. Unknown	38 hours	108°	98.2°	164	66	22,000	4,200,000	30%	
11. 6 hours	60 hours	101°	97.4°	132	62	No rep't			
12. 4 hours	16 hours	103°	99°	112	40	13,800	.....	66%	
13. Unknown	4 hours	99°	97.8°	100	22	No rep't			
14. 4 hours	12 hours	99.2°	97°	100	26	12,300	4,612,000	49%	
15. Unknown	18 hours	100.4°	97°	100	40	15,000	4,200,000	50%	

Nervous System. Coma is prompt after short exposure to illuminating gas. The reflexes are usually completely abolished. The pupils are usually contracted and do not react, but may be dilated, normal, irregular, or respond to light. Temporary nystagmus is common. Muscular twitchings may precede or follow coma.

Most cases present incontinence of the sphincters. Delirium is a usual complication. Hemetson reports a case with convulsions lasting nine days. Among diseases of the nervous system following gas poisoning, the following have been reported: hemiplegia, dementia, acute mania, serous leptomeningitis, disseminated encephalitis, multiple sclerosis, and multiple neuritis.

Urinary System. The urinary findings are for the most part negative. In three of my cases the urine showed evidence of an acute hemorrhagic nephritis.

Skin. The skin is usually cyanosed, cold, and dry. I wish to call attention especially to the appearance of blebs on the extremities and back, usually occurring in chains, in cases in which the coma persists for twelve hours or longer. These bulke contain clear serum, and have frequently been mistaken for the effects of excessive external heat applied in treatment. They were present in five cases, all of which ended fatally.

Temperature. The temperature is usually subnormal during the first twelve hours, and reaction is characterized by a rapid rise, varying from 99° to 103° F. The temperature returns as rapidly to normal as it reached the fastigium.

Vagaries of temperature are due to: Disturbances of normal chemical processes, disturbance of circulatory equilibrium, or altered pulse and respiration.

In cases in which exposure has been prolonged, and in which coma is consequently deep, the temperature rises rapidly, reaching 104° to 110° F. These cases terminate fatally within twenty-four to seventy-two hours. The rise in temperature is usually coincident with the development of œdema, but I do not agree that the sudden development of high fever is caused by the pulmonary condition, but rather incline to the view that it is the result of overwhelming toxemia, the œdema being of hemolytic origin.

DIAGNOSIS. The history of the case is sufficient to make the physician reasonably certain of the diagnosis, but the fact that a patient is found in coma in a room stifling with the odors of illuminating gas without any mode of free entrance of atmospheric air should not be sufficient to forego a careful examination for evidence of other toxic substances introduced by the suicide to make the termination certain. At least a small percentage of the cases of illuminating gas poisoning are complicated by the effects of toxic doses of other poisons capable of producing death.

PROGNOSIS. The prognosis should be based upon a careful and intelligent consideration of the following facts: Duration of exposure; degree of coma; condition of the pulse, respiration, and temperature; condition of lungs; condition of the blood; and the presence of cutaneous blebs. If the exposure be long, the coma is correspondingly deepened and more prolonged. Coma for forty-eight or more hours augurs unfavorably. The onset and rapid

development of œdema with pronounced hemolytic changes is unfavorable. The persistence of anemia and coma with the onset of trophic changes should be looked upon as indicating a most doubtful result. Short exposure to illuminating gas is followed by prompt response to treatment, with recovery. All the cases which develop cutaneous blebs end fatally.

The cause of death is not, in all cases, asphyxia. The leukocytosis, hemolysis, frequency of complications involving the nervous system, and constant pathological changes in the brain and spinal cord, strongly indicate toxemia.

PATHOLOGY. Little was known of the morbid anatomy until the investigations of Thompson in 1904. The most marked changes are found in the blood. The kidneys frequently show evidences of acute nephritis of the glomerular type, and many of the patients who live for twenty-four hours or more undoubtedly succumb to an intercurrent uremia. The lungs may show no changes whatever; however, œdema, acute congestion, and emphysema are common in the cases coming to autopsy. Changes in the brain and spinal cord are by far the most constant pathological findings. Parenchymatous neuritis, multiple sclerosis, serous leptomenigitis, encephalomyelitis, and cerebral hemorrhage have been reported.

TREATMENT. The management of patients suffering from intoxication by illuminating gas has been unsatisfactory, because of the affinity of CO for hemoglobin, and lack of knowledge of the pathological and metabolic processes which the intoxication produces. Inhalation of oxygen has always been unjustly esteemed in the treatment. The use of oxygen by inhalation is of doubtful efficacy, since it seems improbable that the excess of oxygen over that in normal atmosphere can become physiologically combined with the hemoglobin in exchange for carbon products.

The patient should be taken from the room and into fresh air. The tongue should be retracted from the mouth and so retained by means of a hemostat, improvised gag, or tongue retractor. If necessary, artificial respiration should be begun at once. The patient should be removed without delay to an institution or physician's office, where immediate phlebotomy should be performed. A pint to a pint and a half of blood should be removed, and simultaneously a quart of $\frac{N}{10}$ saline solution transfused in the median basilic or cephalic vein of the opposite forearm. Venesection can be repeated two hours after the first bloodletting, if the patient be not doing well. Saline solution should be given subcutaneously every two hours in quantities of one pint, or by the rectum continuously. Saline solution diminishes toxemia, lessens the tendency to œdema of the lungs, increases the affinity of red cells for oxygen, and stimulates the circulatory system. At the outset the patient should be given by hypodermic injection ether, 30 minims, atropine, $\frac{1}{100}$ grain, and

suprarenalin, 30 minims. Nitroglycerin and vasodilators in general should be avoided. Suprarenalin is administered on a rational basis, presuming the œdema, etc., to be the result of increased capillary permeability. The patient should be protected from exposure by an abundance of blankets. External heat should be applied (bearing in mind that the skin is especially susceptible to heat).

While venesection and intravenous injection of saline solution are being done, an assistant should proceed to wash the stomach thoroughly with a solution of potassium permanganate, and follow lavage by the introduction of magnesium sulphate (3 ounces). The respiration and pulse should be watched closely, and stimulated carefully as indicated. Urinalysis should be made daily.

Crile has advocated direct transfusion of blood, and has recently reported results of animal experiments, but his statistics do not show a greater percentage of recoveries than do the active stimulation, venesection, and intravenous injection of saline solution.

DEDUCTIONS. Death from gas poisoning is rapidly on the increase; changes in the blood are conspicuous and severe; toxemia is pronounced; the severity of the symptoms and the duration of the coma depend upon the duration of the exposure; complications of the nervous system are common; cutaneous vesicles appear frequently in severe cases; elevations of temperature occur independently of œdema; poisoning by illuminating gas is sometimes complicated by toxic symptoms of other poisons; saline solution diminishes œdema of the lungs; oxygen is useless; direct transfusion is impracticable; asphyxia is not often the cause of death; the bloodvessels are dilated; the tendency to exudation of serum is increased; suprarenalin in repeated doses is indicated.

CIRCUMSCRIBED SEROUS SPINAL MENINGITIS.¹

A LITTLE-RECOGNIZED CONDITION AMENABLE TO SURGICAL
TREATMENT.

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A COLLECTION of clear fluid in a cyst of the spinal pia-arachnoid is a condition little known in America, as only one case occurring in this country is on record (Spiller, Musser, and Martin,

¹ Read at a meeting of the College of Physicians of Philadelphia, December 2, 1908.

1903), and only a few are to be found in the German literature. So far, the French and English journals contain no examples. A recent excellent *resume* of the subject by S. Adler makes a complete critical digest by me unnecessary, and yet, because of the little attention paid to the condition, it has seemed desirable to bring the subject before the College.

Almost nothing is known as to the origin of apparently idiopathic collections of fluid within the pia-arachnoid. The fluid may be from the bloodvessels of the pia, as has been suggested, and the mesh-like structure of the leptomeninges may predispose to adhesions, but why these cysts occur in any given case, especially where there are no evidences of inflammation, we do not know. The symptoms are those of circumscribed compression of the spinal cord, and the condition cannot be distinguished clinically from tumor of the cord. It is of great importance, as operation is easy and cure seems to be permanent in typical cases.

In the report of the case of Mendel and Adler, in which an operation was performed by the latter, it is stated that the much-swollen arachnoid protruded through the dura at the operation and appeared violet-blue in color, apparently exactly as in the case we reported. The arachnoid was punctured, and about a teaspoonful and a half of clear fluid escaped in a strong stream and was lost in the bandages. The intra-arachnoidal cavity in which the fluid had been contained was found closed at all parts by adhesions. The improvement after this operation was very marked.

Krause and Oppenheim made their first report of this condition in 1906, but they did not refer to previous work on the subject. This was not extensive, and consisted of the reports of three cases (Schlesinger, Schwartz, and Spiller, Musser, and Martin²). Schlesinger, in his well-known monograph on spinal tumors, gave the history of a case in which a cyst of this character was found at necropsy. Schwarz's case (1897) was one with the symptoms of syphilitic spinal meningitis, and after death intense meningomyelitis was found, with a meningeal cyst. This seems to have been a case different from the typical examples, in that closure of a space within the pia-arachnoid might easily occur from the intense meningeal inflammation. Neither of these cases was with operation. The first case reported anywhere with operation was the case by Spiller, Musser, and Martin.

In that case a delicate pial cyst was found and evacuated by Dr. Edward Martin. The operation was on June 30, 1902. The patient had suffered intensely. She has been reëxamined by Dr. Musser and me within the past few weeks, and she has now no symptoms of her former trouble except slight pain in one buttock when she presses over the scar made by the operation. She has gained much in weight and is in excellent health.

This is not only the first case with operation, but is the only one on record in which recovery has persisted after operation so long as six years and five months.

Krause, in operating on 22 cases of spinal compression, expecting to find tumor, found circumscribed serous meningitis in six, although it is not certain that this was the only lesion. Adler remarks that the condition is not a scientific curiosity, as some may think, but is of practical significance. He refers to a case seen by Stroebe. A very similar condition on the under surface of one cerebellar lobe has been described by Placzek and Krause.

The associated lesions that have been found are: Necrotic osteitis of the vertebræ with pachymeningitis (Krause); scar-like adhesions between the dura and pia, probably with spinal gliosis (Krause); bony projection on the inner surface of a vertebra (Krause); and meningomyelitis (Schlesinger, Schwarz).

As Adler remarks, no cause was found in the case reported by him with Mendel, nor in one case of Krause, nor in the case of Bruns, nor in our case. Adler is inclined to believe that in the case reported by himself and Mendel tuberculosis may have been present, as the patient had had pulmonary tuberculosis; and he hesitates, on the basis of four cases, to speak of an idiopathic form of circumscribed serous meningitis. He suggests the possibility of spinal puncture, and refers to the fact that after operation the fluid does not seem to collect again. Bruns, stimulated by Mendel and Adler's³ paper, publishes his case more in detail, and reports almost complete recovery two years after the operation.

A case reported by W. C. Krauss hardly belongs to this group of cases, as the cyst was not confined to the pia-arachnoid. The diagnosis of spinal tumor was made, but an extradural cyst in eroded vertebræ was found. Dr. Roswell Park states, however: "It seemed evident that there was a cavity with eroded walls connecting with the spinal canal, containing mostly fluid, with a little semi-solid tissue material."

It is questionable whether the spinal cyst described by Schmidt should be included under this type. It was intradural, but not a cyst of the pia. Its wall had the consistency of the dura.

Although the literature on circumscribed serous spinal meningitis, as shown by this *resume*, is meagre, it is sufficient to stimulate us to pay attention to the condition and to encourage us in the belief that certain cases with the symptoms of spinal tumor may be more amenable to surgical intervention than are many tumors.

³ Berl. klin. Woch., August 31, 1908. The literature is given in this paper; Bruns, *ibid.*, September 28, 1908; Krauss, *Brain*, 1907, xxx, 533; Schmidt, *Deut. Zeitsch. f. Nervenheilkunde*, 1904, xxvi, 318.

VARIX OF A PAPILLA OF THE KIDNEY A CAUSE OF PERSISTENT HEMATURIA.

BY HUGH CABOT, M.D.,

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DURING the last few years the attention of genito-urinary surgeons has been attracted to the more obscure forms of hematuria by the reporting of a large number of cases in which no sufficient cause for bleeding was made out, in some cases even after the kidney had been removed. The classification of these cases is still chaotic and unsatisfactory.

In 1898 Mr. Hurry Fenwick reported a case of papillectomy for intermittent hematuria of five years' duration, in which the pathologist reported varicose veins in the mucous membrane covering the papilla. Since that time he has reported five cases of a somewhat similar nature in which the lesion appeared to be changes in the venous blood supply about the papillæ.

As far as I am aware no similar cases have been reported in this country. The following is a case of this apparently unusual condition:

Mr. A. B. S., aged fifty years, entered the Massachusetts General Hospital, September 27, 1907, in the service of Dr. Maurice H. Richardson, through whose courtesy I am enabled to report the case.

Thirty years ago he strained his back lifting, and immediately afterward passed what was thought to be bloody urine. From time to time since, often at considerable intervals, he has passed blood without any subjective symptoms, and has given the matter little thought. Seven months ago hematuria returned and the urine has since been bloody about one-third of the time. Five weeks ago he had sudden sharp pain in the left side about the level of the iliac crest. The pain lasted three hours, was colicky in character, tended to shoot upward and inward, and was accompanied by vomiting. There was no pain on micturition. Urine was voided two to four times a day, and three or four times at night. This is a slight increase in nocturnal frequency over previous years. This attack led his physician, Dr. E. T. Drake, of Franklin, New Hampshire, to regard the case as one of stone in the ureter.

The patient was a fairly well-developed, anemic, somewhat cachectic man. The heart sounds were regular, somewhat distant; there was no murmur, no enlargement of the heart, and the chest was otherwise normal. The abdominal examination was negative. The left inguinal glands were slightly enlarged. Rectal examination showed the prostate to be normal.

On September 27, examination of the blood revealed the hemo-

globin, 70 per cent., the leukocytes 5000. A differential count was as follows: Neutrophiles, 60 per cent.; lymphocytes, 38 per cent.; and eosinophiles, 2 per cent. One normoblast was found.

On September 27, the urine was bloody in color, acid in reaction, contained a slight trace of albumin, but no sugar. The sediment was made up largely of fresh and degenerated blood corpuscles, leukocytes, and a little free fat. From this time until October 5 the urine remained practically the same. Cystoscopic examination showed a normal bladder, and blood in considerable amount coming from the left ureter, the orifice of which was normal.

The condition of the patient was such as clearly to require relief, as his anemia showed no improvement and tended to increase; x-ray examination was negative.

Operation was done October 5 by Dr. M. H. Richardson. The kidney was exposed through an oblique incision on the left side, running from the tip of the twelfth rib downward and forward. An apparently normal kidney was delivered without difficulty. Palpation of the kidney and the upper portion of the ureter failed to show anything abnormal. The patient's condition was such that a nephrotomy with its attendant possibilities of bleeding seemed to Dr. Richardson unwise, in which opinion I entirely concurred. The choice, therefore, appeared to lie between decapsulation and nephrectomy. The latter operation was decided upon and done without difficulty. The patient stood the operation well. Upon the following day he passed a good amount of urine, although it was still markedly blood stained. Two days after the operation the urine was clear and remained so up to the time of discharge from the hospital, two weeks later. On April 25, 1908, the patient reported by letter that he has been entirely well since the operation and steadily at work. The twenty-four-hour amount of urine on April 28, 1908, was twenty-seven ounces; it was free from albumin.

The kidney was submitted to Dr. William F. Whitney, who has recently reported his observation to the Obstetrical Society as follows: "I examined it at once, and in general it appeared as a somewhat pale but otherwise normal kidney. On closer inspection it was noticed that the tips of one or two of the papillæ at one end of it were reddened and a little spongy. These were cut out at once carefully and hardened in Zenker's fluid, embedded in paraffin, sectioned, mounted, and stained with eosin and methylene blue. The microscopic examination showed the small venules at the tip of the papilla dilated irregularly to twice or three times their normal size, and covered on their free surface with the finest possible film of connective tissue and a single layer of epithelial cells. Here and there they projected as varicose knuckles above the surface (Figs. 1 and 2). The conditions, in fact, were such that the slightest violence must have caused a rupture with subsequent escape of blood. In one specimen a rent was found in one of these thin-walled channels,

but it cannot be stated positively that it may not have been an artifact. The lumen of the vessels, in many places, was filled with a finely granular detritus and occasional blood corpuscles, but no

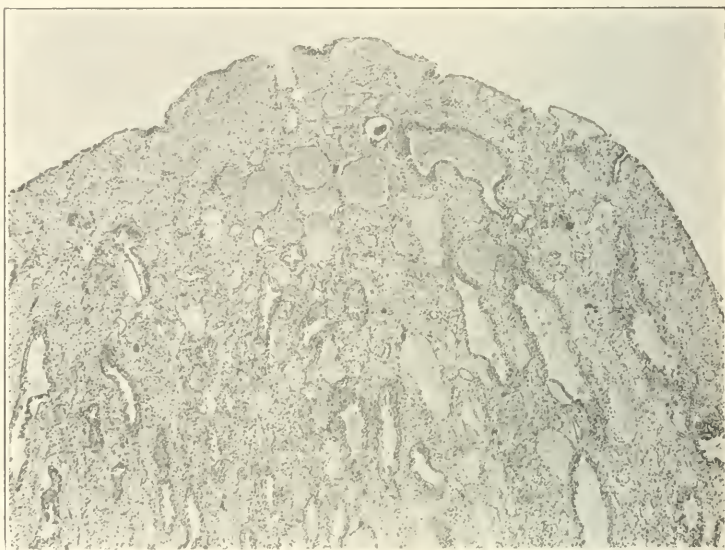


FIG. 1

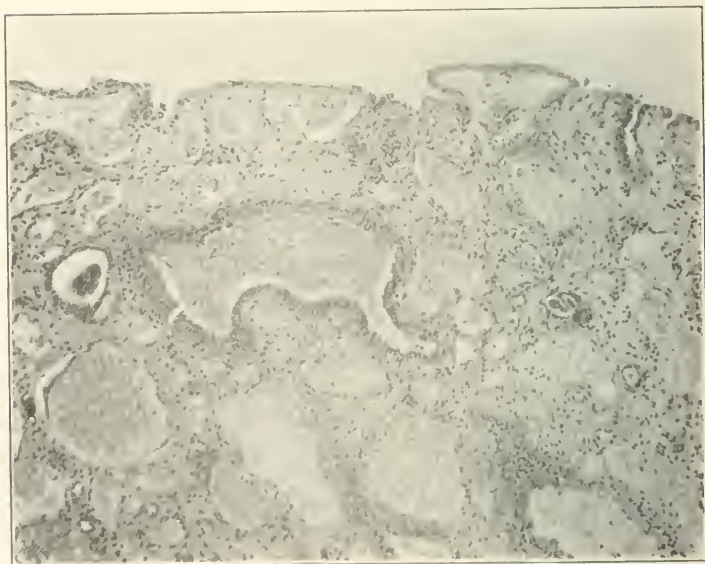


FIG. 2

Dilated venules at the tip of a renal papilla.

well-marked thrombi were seen. That the hemorrhage must have taken place here, however, is borne out by the fact that the straight tubules of this region contained blood corpuscles, which were not found higher than the base of the pyramids. The anatomical conditions described are certainly adequate to cause frequent and severe hemorrhage, for we have only to call to mind what an insignificant lesion will produce a very severe epistaxis to realize what might happen after the rupture of one of these small varicose vessels. It is interesting to find what an abundant vascular plexus there is at the apex of the normal papilla, and by what thin tissue the vessels are separated from the external surface. The size of the normal vessels, however, is very much less than in this case, so that their covering is actually and relatively very much thicker. It is only to be wondered at that hemorrhage is not much more frequent from this source, and it possibly may be and may account for blood found in the urine in some cases of congestion of the kidney."

The only other similar cases are the six of Mr. Fenwick's¹ above referred to, which are here briefly summarized:

CASE I.—March, 1898, female, aged eighteen years. Intermittent hematuria for five years. Papillectomy. On examining under water it was not villous as was supposed, but the vessels of the mucous membrane clothing the papilla were markedly varicose. Mr. Targett reported there was no evidence of growth, but there was congestion of the vessels with extravasation of blood and an increase in the cellular stroma. This might be an early stage of a fibrous condition such as is not uncommon at the tips of the papillæ.

CASE II.—September, 1899. A female with profuse hemorrhage two weeks before without any other symptoms. At operation a bright-red varicosed condition, similar to that which had been encountered in the first case, was seen. Papillectomy. Mr. Targett reported the vessels in this part of the kidney distended with blood, and some extravasations.

CASE III.—July, 1902, male, aged thirty-six years. Hematuria on slightest exertion. Pelvis opened and blood seen to issue from lower infundibulum. Sulphate of iron applied; no benefit. Nephrectomy two months later. Kidney was found in a state of subacute nephritis, possibly the result of first operation. Regards it as primarily an angiomatous papilla.

CASE IV.—Male. Hematuria for eight weeks. Operation consisted of an incision into the cortex of the lower third without entering the pelvis. Bleeding disappeared after a few days and healed rapidly. No return at the end of six months.

CASE V.—April, 1898, male, aged thirty-eight years. Ten days previous symptomless hematuria. Cystoscopy: bloody efflux from left ureter. Operation: The finger was inserted into the pelvis

¹ *Clinical Cystoscopy*, London, 1904, p. 392.

through a deep incision in the cortex of the lower third. Hemorrhage ceased and had not returned after a year

CASE VI.—September, 1902, female, aged forty years. Had dark blood in her urine for two years continuously without symptoms. Operation: A deep incision made in the convexity of the cortex of the lower third. Hemorrhage persisted. Two months later nephrectomy. On dissection a dark purple papilla appeared and oozing from a bright point in the apex was a little blood. Mr. Targett reported that the cortical tissues appeared quite healthy both as regards the glandular tubules and the glomeruli, but on passing up the papilla toward the pelvis of the kidney was found an extensive dilatation of the small vessels running up the papilla. Indeed, the condition was so marked at the summit of the papilla that it constituted a capillary nevus or angioma, and many of the larger vascular channels were distended with clots. In consequence of this growth of vessels the papilla was greatly enlarged and the covering of transitional epithelium was greatly thinned or actually wanting at the apex. The capillary vessels must, therefore, have been placed in direct communication with the cavity of the pelvis of the kidney.

TREATMENT. For most cases of this condition it seems that nephrectomy is an unduly radical operation, although in the present instance it was amply justified. Decapsulation and nephrotomy are likely to be valueless, because they fail to attack the essential lesion, and if they give any benefit it is because the general congestion is diminished. Mr. Fenwick has had some success with the somewhat blind destruction of the papilla, through a short incision in the cortex, but the method is somewhat less accurate than the condition requires for satisfactory treatment.

Since in practically all of these cases it is possible to deliver the kidney so that the pelvis is readily accessible, it is at least possible that a free incision into the pelvis and exploratory pyelotomy would enable the lesion to be dealt with under direct vision. If the spongy tissue can actually be seen it would not be difficult to destroy the superficial vessels with a properly constructed electrocautery. There is, I believe, every reason to expect that future investigation will show this condition to be a not uncommon cause of hematuria, and one which can be dealt with without sacrificing the kidney.

THE PROBLEM OF IMMUNITY IN TUBERCULOSIS.¹

BY EDWARD R. BALDWIN, M.D.,
OF SARANAC LAKE, NEW YORK.

It is my purpose to take a brief retrospect of past achievements in attempts artificially to protect against tuberculosis, and then to indicate what seems to me the special problems for the future. It must be confessed that much discouragement has resulted from the numerous experiments on animals in this direction during the past two decades. This problem has engaged the thought and labor of the foremost workers in immunity research, and it will continue to do so with the enthusiastic hope inspired by every new discovery, however little it may contribute to the ultimate object.

A review of the achievements already attained, with due credit to the authors for priority, is peculiarly difficult, and also impossible in the limits of this address. The difficulties are real because of the simultaneous experimentation in different laboratories and countries, which have independently followed similar lines impelled by the same ideas. The most important example of this common *motif* is the principle of immunization with bacteria of attenuated virulence, formulated by the immortal Pasteur and applied to tuberculosis as soon as the illustrious Koch made it possible by the discovery of the bacillus. It is noteworthy that this principle holds at present the leading place in the hope for success in the future, and it is natural that these experiments should have begun in France (Darembert, Grancher and Ledoux-Lebard, Martin, Hericourt and Richet, and Courmont and Dor). The immediate results were discouraging; too little was known of the mechanism of immunity to make use of the crude methods then employed as a basis for thorough experimentation; and the discovery of tuberculin and antitoxins for other diseases directed attention to these fields of greater promise.

As it is not generally known that Americans engaged in the earlier experimentation with a considerable degree of success, it is appropriate that they should receive mention here. As early as 1889 Dixon made some preliminary experiments with attenuated bacilli, and Trudeau, working under exceptionally difficult conditions, produced a relatively strong immunity with cultures of avian tubercle bacilli (1892), and later with attenuated human cultures. The late Emil de Schweinitz, in 1894, had more marked success on guinea-pigs immunized with the same attenuated cultures employed in Trudeau's experiments. This period was also one of diligent but unsuccessful search for antitoxic immunity by means of divers extracts and products of the tubercle bacillus. The soluble extracts of tubercle bacilli having failed to immunize

¹ Read at the International Congress on Tuberculosis, Washington, D. C., October 1, 1908.

animals, Koch introduced the emulsions or new tuberculins, "T. R." and "B. E.," which were in some degree protective against infection.

Experiments with pseudotubercle bacilli and mammalian types, supposedly altered by passage through reptilians, also promised fruitful results, but they have not fulfilled this hope up to the present time.

The discovery by Theobald Smith, in 1895, of differences in form and virulence between bacilli from bovine and human sources, was another valuable contribution destined to influence the course of immunity experimentation on cattle. Pearson and Gilliland in America were among the first to attain a high degree of immunity in cattle by the use of the human type of bacilli, following up their first work by an extensive series of practical tests.

During the past decade many workers have turned to the study of immunity against tuberculosis in cattle. Von Behring and Koch with their associates have introduced methods of immunization for cattle, the basis of which was the intravenous inoculation of living human cultures. The "bovovaccin" of von Behring consisted of dried human cultures designed to be twice inoculated within an interval of three months. The "tauruman" of Koch and Schütz was an emulsion of more virulent human type for a single protective inoculation. Coincidentally, Pearson and Gilliland succeeded equally well with successive inoculations during shorter intervals. Besides these methods von Baumgarten employed subcutaneous inoculations with good results, Calmette and Guérin used the gastro-intestinal route by feeding the protective virus, and Heymanns enclosed virulent bacilli in capsules which were introduced subcutaneously for immunization without resulting danger of infection. Klimmer, of Dresden, claims excellent results from the subcutaneous injection of a virulent and modified human bacilli supposed to be passed through lizards.

The world-wide interest created by von Behring's announcement, in 1902, of a practicable method of immunizing calves, led to the hope that this aspect of the problem had been solved. An enduring immunity for cattle with no danger associated with it was an alluring prospect, and extensive experiments were at once undertaken. The outcome of these has been less satisfactory than was hoped for. A high degree of resistance can be conferred by various methods of inoculation with human and attenuated bovine bacilli for a period varying from six months to two years. Unfortunately, exposure to natural infection or to inoculation with bovine virus after this period has resulted disastrously. Some of the animals completely lose their immunity and others retain but little of it. The situation is, therefore, at present not encouraging for the establishment of a long-continued immunity by any method, either in cattle or men.

Moreover, the use of living virulent bacilli as a bovine vaccine, either intravenously or subcutaneously, cannot be regarded as safe,

since they have been discovered in the subcutaneous abscesses and milk at least nineteen months after the protective inoculation (Schroeder and Cotton, and Weber and Titzze). The trend of experimentation has naturally been toward the use of bacilli either deprived of reproductive power or modified by conditions of growth so as to lose parasitic features. The possibility of a strong relative immunity has been demonstrated, but much yet remains to be accomplished to make it useful.

To overcome the objections due to the use of living human bacilli in cattle, and to apply the principle of immunization to mankind, have been the problems of recent years. Hope of this achievement was held out by von Behring at the last International Congress at Paris in 1905. Nothing definite has been made public since to indicate that this hope was justified or that the immunizing and therapeutic properties of the so-called "tulase" were superior to the bacillary preparation T. R. of Koch, introduced a decade before.

One fact has been prominent in the course of all investigations, and that is the superiority of living bacilli over all the preparations of dead bacilli for protective inoculation. The vital element has a more pronounced influence, even upon animals which completely resist infection by the immunizing vaccine and show no trace of the inoculated bacilli a short time afterward in their tissues. It is natural to suppose that the bacilli perish too quickly to adjust themselves to a parasitic existence by producing any hypothetical secretion, which might be the secret of their greater protective influence. It is admitted, however, that the degree of immunity is directly proportional to the virulence of the vaccine. The subtle difference between the immunizing value of living and of dead bacilli needs more investigation; likewise also the cause of variations in virulence.

Repeated protective treatment must be considered necessary for success from the present outlook, and by means of an agent equally innocuous to cattle and mankind. It has been found that a period of two months after the first immunizing dose is required to develop the specific resistance in calves. Obviously, they must be protected from exposure to infection during this period. Probably the subsequent protective treatments will more quickly become effective.

It appears desirable to establish as strong local resistance as possible by subjecting all avenues of infection to local immunization; for example, by feeding and inhalation of the vaccine.

In order to adjust the dosage and intervals the finer mechanism of immunity must be closely studied. The agglutinin and opsonin tests have not been satisfactory measures of resistance, and some way of estimating specific latent antituberculous cell energy is needed. When natural infection is taking place or the individual is undergoing immunization there are, it is true, evidences of

changes in the blood, but when no such stimulus is active the content of antibodies—agglutinin, opsonin, or lysin—slowly drops to a normal level. There is then no sign of the latent specificity which we are as yet able to recognize, although a renewed infection or a tuberculin test may elicit it.

Another phase of the problem is to establish a correct balance between the specific response to infection, which occurs during the hypersensitive stage of immunity and the ability of the tissue cells to assimilate the poisons without harm.

An immunity that tends only to arrest the infection but not to overcome it, is not wholly beneficial when it creates ulceration at the portal of entrance of the bacillus (Th. Smith). Hence the question whether hypersensitiveness artificially induced by protective inoculations is beneficent or otherwise must be considered. It would seem vastly better, from what we know of the effects of hypersensitiveness in heightening the affinity of the body cells to a harmful degree for the poisons of tubercle bacilli, that it should be avoided. Specific bacteriolytic powers are useful in combating bacteria, but not in assimilating the dead and digested body substances of bacteria.

Fortunately the number of bacilli to be disposed of at any given time is small under natural conditions of infection. It is conceivable that a relative tuberculosis immunity without tuberculin susceptibility being produced at some time during its development might be defective. On the other hand, complete tolerance to tuberculin in cattle may be associated with a high degree of resistance to infection.

The problem, therefore, seems to be to create tolerance for the bacillus poisons and its products which have resulted from lysis, or to aid their safe assimilation by the tissues.

Without the unknown quality called "tolerance" no real immunity can exist, and the earlier in life this can be established with absolute safety the more resistant the adult must become. That there is danger of harm in the process may easily be surmised from the grave impairment of nutrition resulting from experiments with dead bacilli, and the well-known anemia accompanying so-called latent tuberculosis. These difficulties I conceive to be the prominent ones, but they are here treated in a confessedly superficial manner.

The studies of Bartel on the influence of lymphatic cells upon the tubercle bacillus, as well as those of Opie on the leukocytes, promise to enlarge our knowledge of this subject. Still more light may come from investigations now in progress on the mechanism of anaphylaxis and its prevention.

Finally the problem of passive immunity is still a distant goal which should not be forgotten. It must not be thought hopeless considering the progress of biologic research, though a serum therapy furnishes but a faint probability of success. Some other method of

directly neutralizing the cell poisons may yet be discovered with the increasing facilities generously being devoted to medical research. On this rests the hope of an efficient therapy to supplement all other means of prevention and cure.

THE CAMMIDGE REACTION IN EXPERIMENTAL PANCREATITIS.¹

By JOHN SPEESE, M.D., AND EDWARD H. GOODMAN, M.D.,
OF PHILADELPHIA.

(A preliminary report, from the William Pepper Clinical Laboratory of the University of Pennsylvania and the Private Laboratory of Dr. John H. Musser, Philadelphia.)

IT is rather surprising that, despite the great clinical value claimed for his test, Cammidge² has so far made no attempt to control his observations by experimental work. Eichler³ studied the effect of experimental pancreatitis on the urine, producing in one dog hemorrhagic pancreatitis, and in two dogs a diffuse purulent pancreatitis. The urines of these dogs before operation were negative, confirming the observation previously made that the urine of normal men, dogs, and rabbits does not give a positive pancreatic reaction. The post-operative examination of the urine, in each instance, was positive, which led Eichler to conclude that the test is of great value in diagnosing pancreatic disease. As he used the *A* and *B* reactions in his studies, and as these reactions have been severely criticised by Ham and Cleland,⁴ Schroeder,⁵ Gruner,⁶ Wilcox,⁷ and Haldane,⁸ the value of Eichler's conclusions may be questioned.

In 1907 Cammidge⁹ described a third, or *C* reaction, which he claimed does away with many objections raised by his critics. Very little clinical work has been done with the *C* test, apart from Cammidge's own researches, and, so far, no experimental work has been reported. The papers of Cammidge, Schroeder,¹⁰ and Goodman¹¹ have presented so much clinical evidence in favor of the reactions that we deemed it advisable to control these observations by experimentation.

¹ Read at a meeting of the College of Physicians of Philadelphia, December 2, 1908.

² Robson and Cammidge, *The Pancreas: Its Surgery and Pathology*, 1908.

³ *Berl. klin. Woch.*, 1907, p. 769.

⁴ *Australasian Medical Gazette*, 1904, p. 399; *Lancet*, 1904, i, 1378.

⁵ *Amer. Med.*, 1904, p. 406.

⁶ *Lancet*, 1904, i, 1459.

⁷ *Lancet*, 1904, ii, 211.

⁸ *Edin. Med. Jour.*, 1906, xx, 418.

⁹ *Loc. cit.*, p. 252.

¹⁰ *Jour. Amer. Med. Assoc.*, 1908, li, 837.

¹¹ Read by invitation at a meeting of the Philadelphia Academy of Surgery, November 2, 1908, and to be published in the *Annals of Surgery*, February, 1909.

During a study of experimental pancreatitis conducted by Sailer and Speese,¹² the examination of the urine for the Cammidge reaction was productive of such interesting results that we were led to a systematic study of this phase of the question.

In five dogs 10 to 30 c.c. of cottonseed oil was injected into the pancreatic duct, a procedure which causes rapid necrosis of the pancreas. In three of these cases, studies were made of the urine before and after operation, and in two cases the examination before operation was omitted. The dogs were killed eight hours after the operation.

CASE I.—The urine before operation was not examined. The urine after operation gave a positive reaction. Macroscopic examination of the pancreas showed a diffuse necrotic process which involved most of the organ. The microscopic study revealed complete destruction of the tissue.

CASE II.—The urine before operation was negative; the urine after operation was negative. The pathological examination of the pancreas showed neither macroscopic nor microscopic lesions. In this case pancreatitis was not produced, owing to the attempt to inject oil into the pancreatic duct being unsuccessful.

CASE III.—The urine before operation was not examined; the urine after operation gave a positive reaction. The postmortem examination of the pancreas showed a diffuse necrotic process; lesions similar in nature were seen microscopically.

CASE IV.—The urine before operation was negative; the urine after operation gave a positive reaction. The macroscopic and microscopic study of the pancreas showed a diffuse necrotic process.

CASE V.—The urine before operation was negative; the urine the first hour after operation was negative; the urine the fourth hour after operation gave a positive reaction. The usual necrotic appearance following oil injections was seen; the microscopic examination failed to reveal any normal structure except in the tail of the pancreas. The animal in this case was killed four hours after operation.

Encouraged by these results, we thought it of interest to study the urine in cases of non-acute pancreatitis. Ligation of the pancreatic duct seemed to be the simplest method of producing such a lesion. The plan which we adopted in three instances was to examine the urine before ligation of the duct, and at the end of each twenty-four hours following the operation. After a positive reaction was obtained the animal was killed and the pancreas removed for microscopic study.

CASE VI.—The urine before operation was negative; the urine the first day after operation was negative; the urine the second day after operation gave a positive reaction; the urine the third day after operation gave a positive reaction; the urine the fourth day after

operation gave a positive reaction; and the urine the fifth day after operation gave a positive reaction. The dog was killed seven days after operation. An area of induration was found in the head of the pancreas, opposite the point of ligation. This lesion was the size of a large walnut, was distinctly hard, and cut with greater resistance than the remaining portions of the gland. Microscopic study of the indurated tissue showed a subacute inflammatory process, which had caused small areas of necrosis in the acini. A leukocytic infiltration, consisting for the most part of round cells, was seen in the stroma, and, to a less extent, about the acini. Proliferated connective tissue cells were also noted.

CASE VII.—The urine before operation was negative; the urine the first day after operation gave a positive reaction; and the urine the second day after operation gave a positive reaction. The dog was killed on the second day. The pancreas was indurated in an area about the size and shape of a hickory nut, the lesion being directly above the ligature which still surrounded the duct. Microscopic examination showed changes similar to Case VI, but not so extensive.

CASE VIII.—The urine before operation was negative; the urine fourteen hours after operation was negative; the urine the second day after operation was negative; the urine the third day after operation was negative; the urine the fourth day after operation was negative; the urine the fifth day after operation gave a positive reaction; and the urine the sixth day after operation gave a positive reaction. On the sixth day after operation an attempt was made to open the pancreatic duct at the point of ligation. This was unsuccessful on account of the induration about the duct. The first day following this procedure the urine was lost; on the second and third days the reaction was negative; on the third day typical crystals were found; and on the following day the animal died. The urine collected on this day up to the time of death gave a negative reaction. We are not prepared at this time to explain this phenomenon.

From the anatomical lesions produced by these experiments we inferred that a mechanical obstruction of the duct seems to be productive of a positive Cammidge reaction. This led us in Case VIII to attempt the removal of the obstruction caused by the ligature. Our purpose was to see if the reaction would disappear after the pancreatic duct again became patulous. As the reaction did not appear until the fifth day, and as by this time the induration was very marked, the attempt to pass a probe through the duct from its intestinal orifice was unsuccessful.

While not regarding the results of our experiments as conclusive, we believe them, nevertheless, to be very suggestive. Further research has been undertaken to determine the factors concerned in the production of the pancreatic reaction. The results of these studies will be published in our final report.

SOME OBSERVATIONS ON THE SURGERY OF THE GALL-BLADDER AND BILE DUCTS.

By W. D. HAMILTON, M.D.,
OF COLUMBUS, OHIO.

THE influence of microbic invasion with stagnation of bile in producing biliary infection seems to be generally admitted. The stagnation of bile is due, of course, to obstruction to its passage through some part of the biliary tract. Such an impediment may be extrinsic, or it may be located in the gall-bladder, cystic, hepatic, or common duct, or even at the end of the latter, the ampulla of Vater. The infection may be catarrhal, suppurative, or gangrenous. The frequency of gangrene of the appendix is well known; that it may involve but a limited portion of its mucosa is evident; that all of its coats may be thus destroyed at some point, or that the entire organ may become sphacelated, is a fact which has been borne out by surgical experience. That the gall-bladder is more frequently than is generally supposed the seat of gangrene, somewhere in its mucosa, at least, is my belief. Ochsner believes that the shrivelled gall-bladder so often seen accompanying obstruction of the common duct by stone is due to the cicatrization of the gall-bladder following gangrenous cholecystitis.

This probably accounts, in large measure, for the fact that operations during acute biliary outbreaks are more perilous than after subsidence has occurred. The question as to when operation should be done in acute cases, however, is a surgical and not a medical problem. The surgeon should early, if feasible, be afforded the opportunity to decide such questions. Gallstones may or may not follow these infective processes. There may be a cholecystitis, of which gallstones may be the outcome. If this be true, a patient whose illness is the result of the possession of such a gall-bladder may, at an early stage, before concretions have formed, be cured by surgical drainage, although it does not seem to have been proved that cholelithiasis always follows infections of the biliary apparatus. The importance of first eliminating the stomach, duodenum, right kidney and its ureter, and the appendix as the pathological factor is evident.

In the following case, chronic non-calculous cholecystitis was present:

CASE I.—Miss K., aged twenty-eight years, in charge of Dr. Knauss, of Newark, Ohio, had typhoid six years ago, and biliary colic one year later. In the past four years pain was persistent, with occasional vomiting after food, and with tenderness rather high in the right side of the epigastrium. A diagnosis was made of chronic cholecystitis, probably non-calculous. Operation showed a small, thick-walled gall-bladder, high in the costal angle. Chole-

cystotomy was done. There were no stones; thick mucus and some bile were discharged from the gall-bladder. She has no longer either pain after food or other annoying symptoms, and is in good health.

Observation has suggested to me the possible effect of tight lacing upon the gall-bladder and bile ducts. It may drive the liver, with the gall-bladder, upward toward the costal angle, or, if to a lower level, the fundus may be found at times below the umbilicus. If in either position the liver and gall-bladder be constricted, the flow of bile through its customary channels might readily be interfered with; and as the gall-bladder is the storehouse for a considerable quantity of bile at certain stages of digestion, it is fair to assume that it may be a physiological sufferer from such constricting influences. Post-mortem evidences of the harmlessness of gallstones may be built upon error. Full and reliable knowledge of the cases is derived rather from operative experience, at which, as Moynihan aptly says, "the pathology of the living may be learned." The operation may clear the doubts and establish the pertinent pathological facts. In this and in no other way with so much certainty and beneficence may diagnosis, surgical treatment, and cure in a large proportion of cases go hand in hand. There is no known solvent for gallstones (Robson). The medical treatment may mean a resort to Carlsbad or some noted spa, while perhaps delay or palliation may imply uncertainty, or even danger of an acute attack. If the patient's general condition permit, gallstones should be removed by operation. Most of those individuals who come into the surgeon's care are obliged, if possible, for pecuniary reasons to get well, hence operative interference seems imperative in most gallstone cases.

Three of the gallstone cases in this series had inoperable cancer of the gall-bladder and liver, showing a conspicuous danger of prolonged irritation excited by gallstones.

Pancreatitis, in my experience, is a rather common complication of gallstones. Robson quotes Helly's results of 100 dissections of the common duct, showing that in 62 of them the lower end of the common duct is embraced by the head of the pancreas. Chronic inflammation affecting the head at least of the pancreas would be very liable to choke the common duct there, and produce jaundice. Robson has proved that the common catarrhal jaundice so familiar to medical men is often, in fact, due to chronic pancreatitis. A chemical pancreatic reaction of the urine has been shown by him to be present in cases of catarrhal jaundice, showing it to be a chronic pancreatitis, which operation has both proved and cured—by either cholecystotomy with prolonged drainage, or by cholecystenterostomy, thus short-circuiting the flow of bile from the liver through the gall-bladder into the duodenum.

Indigestion and pain after taking food are conspicuous symptoms of gallstones, as will be shown by the following history:

CASE II.—Mrs. M. C., aged forty-seven years, a patient of Dr. Turner of Columbus, Ohio, had been subject for ten years to agonizing pain in the stomach and epigastrium. Indigestion had been a great source of annoyance to her. Cholecystotomy performed August 31, 1907, showed one large stone in the gall-bladder and much bile sand. She is now well.

Sometimes emaciation is an added effect, as the following case with blocking by stone in the cystic duct will show:

CASE III.—Mrs. E. C., aged forty years, brought by Dr. R. Richison, of Van Wert, Ohio, had lost sixty pounds in weight in the past year. Since August, 1907, has been losing strength, and tires on slight exertion. Had been subject to stomach trouble for nineteen years, more severe of late. There were cramp-like pains across to the right side in the hepatic region. Pain usually comes on two hours after food, with cold sweats. There is a feeling of fulness and weight in the epigastrium. Last attack in November, 1907, confined her to bed three weeks. Operation, February 5, 1908, showed empyema of the gall-bladder, the walls greatly thickened, and one stone of considerable size fixed in the cystic duct. The gall-bladder was removed. She is now in excellent health.

That stones may be lodged in the common duct has been emphasized by my experience. In about one-fifth of the 59 cases the subject of this report, stones were found in the common duct, and required removal, either by choledochotomy, or by coaxing them to the cystic duct, which is sometimes large enough to make them extricable through a gall-bladder incision. The importance of clearing the ducts is evident, for a patient in any of whose ducts stones remain will have further trouble. From the relative scarcity of reports of choledochotomies for the removal of stones from the common duct, I am led to believe that incomplete biliary operations are not uncommon.

The next case cited shows the chronicity of common bile duct obstruction. It illustrates also the ague-like chills, fever, and sweats from obstructive and infective cholangitis, when present:

CASE IV.—Mrs. J. F., aged sixty-five years, a patient of Dr. K. A. Norris, of Columbus, Ohio, had been subject to biliary colic for twenty-five years, more frequently of late, and accompanied by jaundice, vomiting, and fever. Operation, March 11, 1907. The small, shrivelled gall-bladder was adherent to omentum and duodenum. Cholecystotomy found one stone, large as a filbert, in the gall-bladder. A second stone, two-thirds as large as the other, lay at the duodenal orifice of the common duct. It was delivered through an ordinary choledochotomy incision. A rubber drain was stitched in the common duct, while a gauze drain was put in the gall-bladder. She recovered, had melancholia during the past year, but is quite free from former attacks, and improved in general health.

That jaundice is absent in some cases, and that even youth is

not exempt from stone in the common duct, is shown by the following history:

CASE V.—Mrs. —, aged twenty-two years, a patient of Dr. Rank, of Newark, Ohio, had indigestion for thirteen years. There was no vomiting or jaundice. She had right infrascapular pain, and slight tenderness over the gall-bladder and common duct. The examination of the gastric contents, which is customary in all such cases in our service, showed a decided excess of hydrochloric acid, which with pain after food strongly suggested chronic gastric or duodenal ulcer, for which she had been treated for a considerable period before admission. Operation, October 2, 1907. Twenty small stones were removed. Most of them came from the gall-bladder; one from the cystic duct, and several from the common duct. The stomach and duodenum were apparently normal. Drainage was employed in the gall-bladder, right kidney pouch, and common duct. When last heard from she was gaining in weight and was in good health.

Even the hepatic ducts may be the seat of concretions:

CASE VI.—Mrs. W. B., aged forty-nine years, a patient of Dr. Case, of Mt. Gilead, Ohio, has had biliary colic at times for seventeen years, and had had jaundice with attacks. She was tender over the gall-bladder. Cholecystotomy and choledochotomy were done. The gall-bladder contained some concretions; the hepatic and common ducts were found packed with stones. She had cirrhotic changes in the liver from prolonged irritation of stones in the bile ducts. When last heard from she was in perfect health.

A concretion may be lodged so firmly in the ampulla as to necessitate transduodenal choledochotomy, as is shown by the following case:

CASE VII.—Mrs. E. W., aged forty-one years, in charge of Dr. Gahm, of Jackson, Ohio, for seven years had been subject to abdominal pain. There were four periods of invalidism. The first one lasted three months; the second two weeks; the third lasted one week in August, 1905. The last one, which extended over a period of six weeks, led up to her admission to the Mt. Carmel Hospital, February 11, 1906. Jaundice, chills, pain, and moderate emaciation had supervened. Operation, February 15, 1906. The gall-bladder was small and adherent to the duodenum. In handling, it broke open at the beginning of the cystic duct and bile escaped freely. There were no stones in it. The common duct was opened, and after a prolonged exploration a stone was found in the diverticulum of Vater. It could not be withdrawn. The common duct barely admitted the exploring finger. Firm adhesion of the duodenum to the common duct made the digital exploration more difficult, while extraction of the stone through the ordinary choledochotomy incision failed. Upon incising the duodenum, a stone the size of an olive was exposed and withdrawn from the ampulla

by lacerating the tissues overlying it. The duodenal incision was carefully stitched and the omentum secured by one suture over it. The gall-bladder was removed and a clamp left on the cystic duct and artery. A rubber drain was stitched to, but not inserted into, the common duct. A stab wound was made in the right loin through which a rubber drain was inserted. Packing was carefully used throughout the procedure. Some hemorrhoids were operated upon, as they had been causing hemorrhage and annoyance. Her convalescence was delayed by an infection of the parotid region, which required an incision for the evacuation of pus about ten days after the operation. A recent report from Dr. Gahm states that she is now in perfect health.

The following history seemed, from the result obtained, to justify another kind of procedure—cholecystenterostomy:

CASE VIII.—Miss G., aged forty-five years, a patient of Dr. Donley, of Columbus, Ohio, was admitted November, 1903. Her health had been good until six months previously, when she was seized with severe pain in the right upper quadrant of the abdomen. There were vomiting and great exhaustion. This lasted one day and was followed by jaundice. Later, after a period of subsidence, she was again seized with pain followed by jaundice, which continued, and was very marked at time of operation. There was no tenderness over the gall-bladder. The exploration, November 6, 1903, showed the gall-bladder and ducts to be free from stones. The liver was the seat of a diffuse and inoperable growth. The gall-bladder was anastomosed to the transverse colon by means of a Robson decalcified bone bobbin. She had an uneventful convalescence, and is now in excellent health, being apparently quite free from her former annoying symptoms. The growth was thought to be an extensive angioma, although no section was obtained for pathological examination.

The summary of cases given below represents all of the biliary operations performed in the practice of Dr. Charles S. Hamilton and myself between January 1, 1907, and April 1, 1908. Most of them were done in the Mt. Carmel Hospital. There were 59 patients, of whom 56 recovered from the operation and 3 died:

	Cases.	Recovered.	Died.
Cholecystotomies	29	28	1
Cholecystectomies	6	6	0
Choledochotomies	19	18	1
Exploratory, for cancer of the liver, gall-bladder, or bile ducts	3	3	0
Unclassified or miscellaneous	2	1	1
Total	59	56	3

One of the cholecystotomies was done upon a pregnant woman. She went on to term, and was delivered some months later of a well-

nourished child. Her old gastric disturbances and pain are quite relieved.

The following points may be emphasized: When the disease is confined to the gall-bladder, danger from operation is minimized. When the common duct has become the seat of obstructive and infective cholangitis, the operative risk is often greatly enhanced, for one may have a patient who is suffering both from chronic sepsis, and from cholemic intoxication as well. The infective character of the bile should be borne in mind in operations upon many of these sufferers from affections of the biliary channels. Failure to bear this in mind may lead to soiling of the peritoneum and a fatal peritonitis. Rigidity of the right rectus muscle near its upper attachment may have some significance. Either indigestion or something in the way of stomach distress are often manifest in the history of gall-bladder cholelithiasis. One may find tenderness one inch to the right and one inch above the navel in many of the common duct cases (Robson). Tenderness over the gall-bladder is quite likely to be demonstrable, if there has been a recent exacerbation of a cholecystitis. Cramps or pains through the gall-bladder to the right infrascapular region are often observed in gall-bladder or cystic duct cases.

Increasing experience suggests to us the importance of preserving the gall-bladder when salvable. The question as to the possible ultimate restoration of its function, and that of the cystic duct as well, should be carefully weighed before doing cholecystectomy.

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REVIEWS.

MODERN MEDICINE. ITS THEORY AND PRACTICE. In original Contributions by American and Foreign Authors. Edited by WILLIAM OSLER, M.D., Regius Professor of Medicine in Oxford University, England. Assisted by THOMAS MCCREA, M.D., Associate Professor of Medicine and Clinical Therapeutics in the Johns Hopkins University, Baltimore. Volume IV; pp. 865. Philadelphia and New York: Lea & Febiger, 1908.

VOLUME IV of Osler's *Modern Medicine* is devoted to a discussion of diseases of the circulatory system, the blood, the spleen, the thymus, and the lymph glands. C. F. Hoover contributes two chapters: the one, an introductory chapter on different aspects of the physiology of the heart, including an interesting exposition of the myogenic and the neurogenic theories of the heart's action, and of so-called cardiac dyspnoea; and a second chapter on functional diseases of the heart, in which he describes in detail and satisfactorily, without dogmatic theorizing, tachycardia, bradycardia, arrhythmia, angina pectoris, pseudo-angina, Stokes-Adams syndrome, digestive disturbances of the heart, the relation of the sexual organs to disorders of the heart, the irritable and weakened heart, etc. He gives an interesting account of the supposed ischemia of the myocardium to which attacks of angina pectoris are attributed, believing the phenomena analogous to intermittent claudication, and to the epigastric distress after excessive eating in those the subject of gastric arteriosclerosis; and he points out the different classes of cases in which nitroglycerin, on the one hand, and morphine, on the other hand, are indicated. Diseases of the pericardium are well treated by Alexander McPhedran, considerable attention being directed to the physical signs. Diseases of the myocardium are discussed by Robert H. Babcock, acute and chronic myocarditis comprising the major portion of the discussion. The gradual development of the symptoms of chronic myocarditis is especially well portrayed, and some very valuable advice as regards treatment is given. Hypertrophy, insufficiency, and dilatation of the heart are described by Alexander G. Gibson. Among other interesting matters he gives an excellent summary of existing knowledge of the effects of long-continued and ill-advised exercise, and of hypertrophy as a compensatory process. Of the chapter on congenital

heart disease (100 pages), by Maude E. Abbott, it suffices to say that it comprises all that is really known on the subject, excellently digested and well arranged. Dr. Osler himself contributes the chapters on acute endocarditis, diseases of the arteries, and aneurysm, and, in association with Alexander G. Gibson, the chapter on valvular disease of the heart. Together these comprise 160 pages; they may be said to constitute at once the most important and the most instructive part of the book. The infectious nature of all cases of acute endocarditis is pointed out, and emphasis is laid on the fact that there is no benign or simple form. The valvular defects are described in a lucid, instructive, and entertaining manner, and considerable attention is directed to the prophylaxis and treatment. There is a short account of the rarely recognized and scarcely recognizable (except by the French) acute aortitis; and a full, orderly, and comprehensive account of arteriosclerosis, in which the influence of the four great causative factors is well elucidated—the normal wear and tear of life, the acute infections, the intoxications, and those combinations of circumstances which keep the blood tension high. The article on aneurysm is such as one might expect from an author who has already written much on the subject.

George Blumer discusses thrombosis, embolism, and phlebitis. The article is of much value, since it comprises not only a lucid statement of facts long known, but also the results of recent studies, especially the influence in causing thrombosis of agglutination of erythrocytes, of the activities of bacteria, and of the significance of calcium salts. Aldred Scott Warthin describes diseases of the lymphatic vessels and glands, and the thymus. The two chapters comprise a scholarly presentation by one whose painstaking studies and previous publications render him especially well qualified to speak with authority on the subject. The chapters on diseases of the blood are by Richard C. Cabot, and of them it suffices to say that they are worthy of their author. Purpura and hemophilia are discussed by Joseph H. Pratt—critically, comprehensively, and satisfactorily. Diseases of the spleen are well described by Irving P. Lyon.

Of the volume as a whole one may say that it is devoted to a series of diseases which are naturally related, that the classification and arrangement of subjects are very practical, and that the authors, selected with rare skill and because of proved ability, have discharged their obligations with judgment and discernment. Only lack of space precludes more detailed mention of the many meritorious articles included within the volume, which is embellished by a number of illustrations, of which several are many colored plates.

A. K.

A SYSTEM OF MEDICINE. By Many Writers. Edited by THOMAS CLIFFORD ALLBUTT, M.D., F.R.S., Regius Professor of Physic in the University of Cambridge; and HUMPHRY DAVY ROLLESTON, M.D., F.R.C.P., Physician to St. George's Hospital, London. Vol. III; pp. 1040. London: MacMillan & Co., 1907.

VOLUME III of Allbutt and Rolleston's *System of Medicine* is presented to us as a "rewritten rather than a revised successor of Volume III of the original edition." It contains a discussion of general diseases of obscure origin, diseases of the alimentary tract, and diseases of the peritoneum. The diseases of obscure origin include a number that often are referred to as disorders of metabolism, diseases of the joints, etc.; that they are obscure in origin is obvious from a perusal of the different articles—of which, however, one may say that they contain all that is really known of the subjects of which they treat, and some little speculation in addition. A. E. Garrod now distinguishes definitely between what he designates rheumatoid arthritis and osteo-arthritis, which conform closely to the atrophic and the hypertrophic arthritides of Goldthwait; and to the description of these is added a chapter on the articular lesions of infective diseases (gonorrhœa, dysentery, syphilis, pneumococcic infection, etc.). The obscurity enveloping diseases of the joints is perhaps best apprehended by those that know most about them, and if Dr. Garrod has not been able to solve all of the related problems, he has given us a series of as illuminating articles on the subject as can be found in any text-book. J. Rose Bradford's revision of Lauder Brunton's article on gout should commend itself to a wide circle of readers, especially as we are now recognizing the frequency of gout, particularly irregular gout, in this country, and as the practical aspects of the subject and the treatment are well set forth. Professor Saundby's discussion of diabetes mellitus is an altogether adequate presentation of the subject, in which reference is made to the significance of reduction in the sugar-consuming capacity of the tissues in producing the morbid phenomena. More detailed discussion of the relation of disease of the pancreas would have been welcome to those especially interested in the pathogenesis of the disease.

There are many articles on diseases of the digestive tract, contributed by such well-known authors as Bradford, Ralfe, Fenwick, Spencer, Rolleston, Brunton, Allbutt, Leith, Dreschfeld, White, Still, Lockwood, Smith, Slater, Barnard, Allingham, Mummery, and Keith. Perhaps, from the very nature of the subjects discussed, it were idle to expect much that is novel; but mention may be made of two articles by Lauder Brunton—the one on dyspepsia, that presents this ubiquitous disorder in a very interesting and instructive light; and the other on constipation, which is of especial value from a practical point of view. Dreschfeld's article on ulcer of the stomach and duodenum also may be referred to as a model of its

kind; treatment by rest especially is advocated, but some brief advice relative to the indications for operative intervention also is given. The several articles on diseases of the peritoneum by Allchin and Andrews, and that on subphrenic and other forms of peritoneal abscess by Acland, are of a high order of merit. As a whole the volume well sustains the reputation achieved by those that have preceded it; that it will be long referred to as an authority there can be no doubt.

A. K.

GENERAL PATHOLOGY. By ERNST ZIEGLER, M.D., Professor of Pathological Anatomy and of General Pathology in the University of Freiburg, in Breisgau, Germany. Translated from the Eleventh German Edition. Edited by ALDRED SCOTT WARTHIN, Ph.D., M.D., Professor of Pathology in the University of Michigan, Ann Arbor. Pp. 781; 604 illustrations. New York: William Wood & Co., 1908.

A NEW English edition of Ziegler's *General Pathology* is a most welcome addition to medical literature; one greets it as he would an old friend—with interest and pleasurable anticipation. Eleven editions in the original German and translations into English, French, and Italian bespeak a notable achievement, and to this one must add a great influence, direct and indirect, that the book has had upon most of the active practitioners of medicine of today; indeed, most of us have been more or less brought up on the book. The American editor only voices a general sentiment when he states that to it “alone the students of medicine during the past twenty-five years owe a large part of their medical culture, and in this respect its influence upon the recent development of medicine can hardly be estimated.” In the original, Ziegler remains a final authority; the rendition into English has been made without change or omission. But since there has been some material progress in pathology since the death of the lamented author, the editor has brought the book fully abreast of the times by incorporating the important and interesting results of recent investigations, especially such as relate to the effects of Röntgen irradiation, heredity, phagocytosis, opsonins, blood plates, thrombosis, necrosis, cloudy swelling, fatty degeneration, calcification, regeneration, inflammation, malignant neoplasms, tuberculosis, syphilis, relapsing fever, spirochetæ, protozoa, etc. Of the additions, one can unreservedly say that they are worthy of incorporation in the book, that they materially enhance its value. The editor has rendered a real service by making the wealth of information contained within the book available to the English-speaking profession; let us hope that he will translate also the volume on special pathology.

A. K.

PULMONARY TUBERCULOSIS AND ITS COMPLICATIONS, WITH ESPECIAL REFERENCE TO DIAGNOSIS AND TREATMENT. By SHERMAN G. BONNEY, A.M., M.D., Professor of Medicine in the Denver and Gross College of Medicine, Medical Department of the University of Denver. Pp. 778; 189 illustrations. Philadelphia: W. B. Saunders Co., 1908.

IN essaying to treat of the subject indicated by the foregoing title, the author has undertaken a labor of no small magnitude, a task which the reviewer believes has been meritoriously completed. On the whole, it may be said that the views set forth by the author are eminently orthodox. We believe that the value of the work would have been much enhanced if foot-note references had been appended, especially in the case of the more important publications referred to in the text, although it must be borne in mind that the book is essentially based on personal experience, with no attempt at encyclopedic scope.

It would, of course, be impossible to adjudicate all the evidence regarding the most frequent source and pathway of infection, but a very creditable *resume* of the facts has been presented, in which the main arguments of the advocates of the alimentary and the respiratory doctrines are set forth. The author concludes that, broadly speaking, alimentary infection is probably more common and respiratory infection more rare than is generally supposed. Regarding the author's views on the importance of house infection we are left in doubt, as more or less contradictory statements are made in different parts of the book.

In the chapter on physical signs, we are glad to note that undue value is not attached to the importance of inspection, as has been rather the fashion of late. He also, and very properly, advises against the employment of instrumental percussion, another fad which has periods of rejuvenation. Later on, however, he voices what we venture to believe is a somewhat unusual opinion in stating that "tympanitic resonance is found but infrequently over pulmonary cavities." Of course, it all hinges upon what is meant by tympanitic resonance, a point regarding which there seems to be a deplorable lack of unanimity among the profession. The author, however, devotes considerable space to the discussion of acoustics, and gives several pages to the consideration of different forms of stethoscopes, all of which embody much useful information. Among the numerous illustrations we find some very good examples delineating thoracic deformities, and also pulmonary skiagrams. The reviewer failed to find any reference to Grocco's sign of pleural effusion, or of Eustace Smith's sign of enlarged bronchial glands.

Considerable attention is given to the question of climate as a therapeutic measure, the author, not unnaturally, taking a view opposite to that held by many eastern physicians, who are apt

to consider this factor as relatively inconsequential. We are pleased to note, however, the absence of any unreasonable bias on this subject, which is dispassionately discussed. A very satisfactory *resume* of the development and progress of immunity and serum therapy is included, the book being brought to a close with an account of the author's personal experience—one and one-half years—with bacterial vaccines.

As has already been said, the book is one which is in large measure based upon personal experience, a fact which adds largely to its value, since it is the personal element that leaves its impress upon the mind of the reader. The keynote to the character of the book is voiced thus in the author's own words: "No teacher can assume the responsibility of describing what is not to him the actual result of his observation."

G. W. N.

ADENOMYOMA OF THE UTERUS. By THOMAS STEPHEN CULLEN, M.D., Associate Professor of Gynecology in the Johns Hopkins University, Baltimore. Pp. 270. Philadelphia and London: W. B. Saunders Co., 1908.

ANY work produced by Cullen needs no introduction to medical readers. His name has always stood for careful investigation, and in the present volume, no less than in his master work upon uterine cancer, this reputation is upheld. The question discussed in this book is in the main the method of formation of the gland-islands in adenomyomas of the uterus, and the author has so presented his material that the reader is led to accept his conclusions as inevitable. In other words, the man who reads this volume with care will, at its conclusion, have somewhat the feeling that he has himself been engaged in the actual study in the laboratory and that Cullen's conclusions are his own. In order to produce this effect the material upon which the work is based has been presented in full, the photographs of the gross specimens, microscopic sections, and case histories being given.

The generally accepted idea among the majority of gynecological pathologists has been that of von Recklinghausen, who believed the glandular elements to be derived from the Wolffian duct, and although some authors have always ascribed the glandular elements in the majority of cases to the duct of Müller, there has been no definite proof of their position until the present work was accomplished. Space forbids more than a brief mention of the conclusions of the author, but in order to present his argument intelligibly it may be stated that in his series of fifty uncomplicated cases of diffuse adenomyoma of the uterus, he was able to trace the gland-islands in each case to their origin in the uterine mucous membrane, while in the

fifteen cases of subperitoneal or submucous tumors, in which it could not be expected that there would be a direct relationship demonstrable, there was found one case in which the mucosa had literally flowed into the myoma. Even if no such direct proof were available, however, the case would not be weakened, for, as the author says, it is not necessary that the uterine glands be traced by continuity to establish their origin in the mucous membrane, since the islands of glands lying deep down in the muscle correspond identically with those seen in cases in which continuity is traceable, and, moreover, they are identical with true uterine glands, are surrounded by typical stroma, and their function is retained in that in almost all cases in which cyst spaces are present the cavities were seen to contain blood in varying amounts, while in small undilated glands the presence of blood or blood pigment was frequently demonstrable.

The author's work covers a period of fourteen years, he having begun his investigations in 1894, two years before the publication of von Recklinghausen's work, and having continued them up to the present time upon material obtained from Kelly's clinic and his own service at the Church Home and Infirmary. A glance at the case histories at the end of the volume will indicate the wealth of his material. The work was undertaken as the result of one of those fortunate chances which have a peculiar faculty of presenting themselves to the trained observer, even though he be engaged in merely routine work, and this seems to us a valuable though unintentioned lesson which may be gained from the volume.

For clinical purposes the material has been divided into (a) growths associated with a relatively normal uterine contour; (b) subperitoneal or intraligamentary; and (c) submucous forms. The consideration of the first of these divisions comprises three chapters, a single chapter being sufficient for each of the other two. Exceedingly interesting sections are devoted to the consideration of the clinical picture presented by these tumors, their differential diagnosis, treatment, and prognosis. The two chapters upon the origin and causes of adenomyoma are among the most interesting in the whole book. The remainder of the volume is concerned with the rarer conditions met with, as the occurrence of adenomyoma with carcinoma, adenomyoma of the round ligament, etc. The book has been prepared with the utmost care from the standpoint of the publisher, while the illustrations, by Becker and Horn, are, of course, beyond criticism. The arrangement of the letter press deserves special mention in that it has been carried out in such a way that the reader who does not care to follow the author closely through his whole presentation of the subject may, by reading simply the portions in large type, get to the gist of the matter in a very short time.

W. R. N.

DISEASES OF THE EYE. By M. STEPHEN MAYOU, F.R.C.S., late Hunterian Professor, Assistant Surgeon, and Pathologist to the Central London Ophthalmic Hospital. Pp. 388; 119 illustrations, and 8 colored plates. London: Henry Frowde, Oxford University Press, Hodder & Stoughton, 1908.

By far the best part of this book is the mechanical: the paper, type, and binding are models. As for the subject matter, this is about on a par with the usual manual, neither much better nor worse. The pathology, as might have been expected, is the *lest* part. Much of the chapter upon refraction might almost as well have been omitted, for all the information it is likely to impart to those for whom the writer states the book is intended—students who are beginning this subject, and practitioners. The reader already acquainted with the subject can supply the omissions, but the descriptions are entirely too brief for the beginner. The chapters upon the affections of the other ocular structures are upon the whole satisfactory; the question here is simply what to omit, and this will vary with the judgment and bias of individual writers. This writer is very brief upon treatment. A few of the newer methods are given a place, such as Kronlein's operation, decompression in optic neuritis, etc. We fail to find any reference to subconjunctival injections. A couple of paragraphs are devoted to the ophthalmo-tuberculin reaction, which is credited to Calmette. The vision required for the public services in England is briefly described.

T. B. S.

THE TREATMENT OF GONORRHŒA IN THE MALE. By CHARLES LEEDHAM-GREEN, M.B., F.R.C.S., Surgeon to the Queen's Hospital, Birmingham, England. Second Edition; pp. 160; 47 illustrations. New York: William Wood & Co., 1908.

THERE are several points on which stress is laid by the author which deserve passing mention. He disputes the classical interpretation of the role of the prostatic urethra in the presence of an overdistended bladder, claiming that the urethra does not widen out so as to become continuous with the vesical neck; and he presents in support of his views, which have been published previously, a skiagram of the bladder of a living subject which has been distended with a bismuth solution. He insists on the frequency of prostatitis as a complication of posterior urethritis; as well as on the rarity of a true cystitis from the same cause. He prefers local remedies to those administered internally, employing protargol in the early and silver nitrate in the later stages of urethritis. Abortive treatment he regards as practically useless. The use of the

urethroscope is described, and well illustrated. He has observed much benefit from the treatment of gonorrhœal arthritis by means of passive hyperemia. On the whole, the volume, though compendious, presents an adequate account of the disease in question; and that it has been well received is evidenced by the appearance of a second edition only two years after the first. A. P. C. A.

AIDS TO OSTEOLOGY. By PHILIP TURNER, B.Sc., M.B., M.S. (Lond.), F.R.C.S., Demonstrator of Anatomy, Guy's Hospital, London. Pp. 187. New York: William Wood & Co., 1908.

IN the compass of a volume small enough to be carried in the pocket the author has condensed a remarkably complete description of osteology, including form, surface markings, muscular attachments, and the centres of ossification. No one can be an anatomist who is ignorant of osteology; and, unless well grounded in anatomy, the practitioner is rarely above the average as either physician or surgeon. The value of such works as render the acquisition of osteology easier for the student is therefore readily appreciated. The contents of the present volume are of course not original; the descriptions are borrowed mostly from Cunningham, Gray, and Quain. It is on this account, perhaps, hypercritical to blame the author for putting the appearance of the centres of ossification at such late dates. Recent investigations, especially by the aid of the Röntgen-rays, have certainly proved that these centres may be detected much earlier than was formerly thought to be the case. For instance, we have yet to see a skiagram of a child of the age of twelve months in which a centre for the capitellum of the humerus is not visible. Mr. Turner states that this centre appears in the third year. In other respects the volume can be cordially commended to students. A. P. C. A.

ELECTRICAL TREATMENT. By WILFRED HARRIS, M.D., F.R.C.P., Physician to Out-patients, Physician to the Department for Nervous Diseases, and Lecturer on Neurology, St. Mary's Hospital; Physician to Out-Patients, Hospital for Epilepsy and Paralysis, Maida Vale. Pp. 383; 24 illustrations. Chicago: W. T. Keener & Co., 1908.

Too much praise cannot be given to this book. It has the distinction of being written by a first class neurologist, and is not only a safe and sane exposition of the principles and treatment of nervous

diseases, but it also gives the principal diagnostic points and the method of treatment in each disease. The book is mainly concerned with treatment by galvanic and faradic electricity, and in this respect it is excellent and its precepts can be followed without question. The author pays very little attention to sinusoidal and high frequency currents and still less to Röntgen rays and static electricity. It is refreshing to read a work on electrical treatment which does not claim that every disease under the sun can be cured. So many books have been written recently by electrical specialists who claim that every ill to which the human being is heir can be cured by electricity, that electrical treatment of diseases has fallen into partial disrepute and has undeservedly been classed with osteopathy and other similar cults. The fault lies in the fact that the men who treat by electrical methods take too much for granted, and writers upon this subject assume an intimate knowledge of its many subdivisions, an impossible accomplishment. This book limits itself only to treatment of diseases of the nervous system.

T. H. W.

TEXT-BOOK OF OTOTOLOGY FOR PHYSICIANS AND STUDENTS. In thirty-two Lectures. By FR. BEZOLD, M.D., Professor of Otology in the University of Munich, and FR. SIEBENMANN, M.D., Professor of Otology in the University of Basle. Translated by J. HOLLINGER, M.D., of Chicago. Chicago: E. H. Colegrove & Co., 1908.

WE consider the title of this book a distinct misnomer. It would have been better to have entitled it "Clinical Lectures on Otology," as this is entirely the form in which it is written. As might have been expected from the standing of its authors, the book contains much of great value, but as a systematic treatise it lacks entirely the characters necessary to adapt it for the use of the student or learner in otology. The greatest unevenness is shown in the treatment of the various topics, some being treated at length, and others only sketched. Thus, the sections which deal with the anatomy of the ear show a great lack of thoroughness, while those dealing with its physiology show almost excessive minuteness. The same characteristics prevail in the entire work, certain diseases of the ear being considered at great length, and others of equal importance slighted.

To aurists the book will be of value, because they can extract from it much of original worth, and because the views expressed by its authors are, in many instances, of striking interest; but as a guide to the general practitioner and student, it cannot be so highly recommended. It is to be regretted that the translator followed so literally the German idioms. As expressed in English, there is a

most atrocious lack of attention to grammar, and some of the statements as translated are most startling, as, for instance, in the instructions for syringing the ear for the removal of cerumen, the statement is made that the cannula of the syringe is "*pressed* against the rear wall of the cartilaginous meatus," and the nurse is instructed to pull back the auricle "energetically."

It is to be hoped that another English edition of these truly interesting lectures will be demanded, and that when it is brought out, the many minor errors to be detected in the present issue will be corrected.

F. R. P.

WHY WORRY? By GEORGE L. WALTON, M.D., Consulting Neurologist to the Massachusetts General Hospital, Boston. Philadelphia and London: J. B. Lippincott Company, 1908.

DR. WALTON has presented in this small volume his own personal experience in the elimination of worry from his neurotic patients. Rather full consideration is given to this symptom as the expression of various neuroses. It is questionable how far this attempt at popularizing what the medical profession has been pleased to call "psychotherapy" will be of any particular benefit to those afflicted with the neuroses mentioned. The tendency to worry is as much a symptom of neurasthenia as the fever and enlarged spleen is of typhoid fever. Neurasthenia is not the result of the worry as here manifested as a symptom, and it would be quite as rational to induce the typhoid fever patient to eliminate his fever by autosuggestion as it would be to induce the real neurasthenic to eliminate the worry. That those blessed with the nervous temperament, which is so fertile a soil for the development of neurasthenia, are prone to fuss and worry over immaterial things is well known. To such the suggestions of Dr. Walton, if there be sufficient brain power behind the nervous temperament properly to appreciate and carry them out, would be of decided value. The tendency of the brainless and the neurotic to venerate their deficiency with a smattering of anything psychological has its principal effect in leading to introspection those whose minds should be concerned only with externals.

A man with a well-poised brain will derive a certain amount of enjoyment and profit from Dr. Walton's book; a woman of the same type would probably derive more profit than enjoyment from it; a member of either sex, of neurotic type, and especially those in whom the neurotic element is associated with pathological manifestations, will derive neither profit nor pleasure, but in all probability much harm. Marcus Aurelius would at least have been much edified in learning how far his philosophical dissertations were really psychotherapy in disguise. Why worry, indeed?

D. J. McC.

PROGRESS
OF
MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF
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The Pulse Pressure as an Index of the Systolic Output.—P. M. DAWSON and L. J. GORHAM (*Jour. Exp. Med.*, 1908, x, 484) have experimented on dogs, obtaining simultaneous tracings showing the mean blood pressure in the femoral artery by means of a mercury manometer, the systolic output by means of a Henderson cardioplethysmograph, and the blood pressure in the carotid and femoral arteries by means of two manometers. These records are shown on the accompanying charts and plates and bring out the different relations very closely, showing that the pulse pressure (the difference between the systolic and diastolic pressure) may be a reliable index of the systolic output. This was shown in their experiments following stimulation of the central and peripheral ends of the vagus, of the saphenous nerve centrally, of the annulus of Vieussens, in asphyxia, hemorrhage, and infusion.

Congenital Heart Disease.—M. A. ABBOTT (*Jour. Med. Research*, 1908, xix, 77) gives a careful statistical review of 400 cases of congenital heart disease which brings out several important factors more or less at variance with the accepted ideas. Some of these are the great frequency of defects of the interventricular septum, especially in combination with other conditions (149 cases among 400). Next in frequency comes patent foramen ovale (134); patent ductus arteriosus (106). The duration of life is seen to be relatively long in uncomplicated defects of the interauricular septum, patent ductus arteriosus, coarctation of the aorta, and pulmonary stenosis with closed interventricular septum; in pulmonary stenosis with a defect in the septum the duration of life is much shorter. The right chambers are chiefly hypertrophied and dilated in defects of the interauricular septum, transposition of the arterial trunks, pulmonary stenosis, and atresia. Both chambers, but

chiefly the right, are enlarged in defects of the interventricular septum and patent ductus arteriosus; the left ventricle chiefly in coarctation of the aorta. Acute endocarditis is seen to be relatively common in defects of the interventricular septum at the base and in pulmonary stenosis. Cyanosis was not marked in any case and was often absent in most of the defects of the interauricular septum. A moderate degree of cyanosis was fairly common in defects of the interventricular septum. Marked cyanosis was seen chiefly in transposition of the arterial trunks, pulmonary stenosis with defect in the interventricular septum, and pulmonary and tricuspid atresia. Cyanosis was slight or absent in a patent ductus arteriosus. In six cases defect of the interauricular and in four of the interventricular septum the cyanosis was terminal. A thrill was frequent in pure defects of the interventricular septa at the base and in pulmonary stenosis with closed interventricular septum and patent foramen ovale. A thrill was relatively rare in pulmonary stenosis with defect of the interventricular septum and closed foramen ovale. In the great majority of cardiac defects the murmur present was systolic in rhythm.

Insufflation of Air in the Treatment of Pleural Effusion.—C. ACHARD (*Semaine med.*, 1908, xxviii, 445) notes that this form of treatment has been known for some time, being first advocated by Potain in 1889. The precaution of sterilizing the air Achard does not think necessary; in passing through the tube and flask, using an ordinary vacuum or bicycle pump, the air sterilizes itself sufficiently. It takes the place of the heavy fluid, thus relieving the weight on the diaphragm and heart, and at the same time keeping up a gentle compression of the lung. He has used this method often and finds that it is of great help, seeming to prevent or delay a refilling of the pleural cavity, which is so common in some cases. It also obviates all dangers from the too rapid removal of the fluid which sometimes causes pain, cough, dyspnea, and albuminous expectoration. The insufflation should be stopped at once when the patient complains of the least discomfort. This method of treatment Achard has found to be of great service, especially in tuberculous, serofibrinous, or hemorrhagic pleuritis, and in cases of recurring hydrothorax; in those in which the fluid is purulent, surgical measures must of course be resorted to at once.

The Influence of the Reduction of Kidney Substance upon Nitrogenous Metabolism.—R. M. PEARCE (*Jour. Exp. Med.*, 1908, x, 632) notes the importance of the influence of a possible internal secretion of the kidney, if such exist, upon general nitrogenous metabolism. Up to the present time there is little experimental or other evidence to support such a theory of an internal secretion. Pearce's experiments have been along these lines, that is, in removing amounts of kidney substance sufficient presumably to disturb the hypothetical internal secretion. His conclusions are that the removal up to three-fourths of the kidney substances causes no change in the general nitrogenous metabolism, as determined by the estimation of total nitrogen, urea, and ammonia elimination in the urine. The removal of large amounts leads to the metabolic condition of starvation; this, however, is apparently the result of the gastro-intestinal disturbance associated with extensive

kidney reduction and not to a disturbance of general nitrogenous metabolism. The determination of the amount of fecal nitrogen indicates that the gastro-intestinal disturbance is not due to diminished absorption and, except in one instance, there was no evidence of its being due to an increased elimination of nitrogenous substances into the intestine. These experiments then do not support the theory that the kidney furnishes an internal secretion having an important influence on general nitrogenous metabolism. At least if such a function exists it is not disturbed by the removal of three-fourths of the kidney substance. The metabolism in excessive kidney reduction is that of inanition dependent on gastro-intestinal disturbances, presumably due to faulty chemical co-relation. In this connection further knowledge concerning the elimination into the intestines of toxic substances is desirable.

A New Reflex between the Eye and the Circulatory and Respiratory Systems.—ASCHNER (*Wien. klin. Woch.*, 1908, xxi, 1529) has described a new reflex, the discovery of which came about in the following manner: Professor Jauragg in his lectures upon stuporous cerebral affections demonstrated a method by which a patient could be partially aroused even when he failed to respond to excessive sensory excitations. His method involved pressure on the eyes as a result of which the patient began to stir and often regained consciousness to the extent that he responded to simple questions. No explanation of this phenomenon was offered. Aschner had an opportunity of testing this in von Eiselberg's clinic upon a patient who remained under the influence of the anesthetic an unusually long time after completion of an operation. Calling, shaking, dashing cold water in the face, tickling the nose, pinching, all failed to elicit any response from the patient. Pressure on the eyes was followed by flushing of the face, deep breathing, slight movements, and finally opening of the eyes. During a repetition of the experiment Aschner felt the patient's radial pulse and was astonished to feel it disappear under his fingers. A slowing of the pulse was first noted and this immediately suggested irritation of the vagus. Two possibilities existed: (1) Vagus irritation from increased intracranial pressure and (2) a nervous reflex. On animals the experiment succeeded after opening the skull so that increased intracranial pressure was eliminated as a cause. After cutting the trigeminal nerve, especially after severing it intracranially, the phenomenon was lost. Cutting of the optic, olfactory, motor oculi, trochlear, abducens, auditory, and facial nerves produced, on the other hand, no loss of the reflex. After section of the vagus in the neck the reflex is occasionally obtainable. Whether in this case excitation of the vasoconstrictor centre with increase of the intracardial pressure occurs remains to be investigated. Effects upon the respiration are more marked in rabbits than in dogs or man. Pressure on the eyes as well as electric stimulation of all three branches of the trigeminus produced changes in the breathing, inspiration becoming spasmodic with inspiratory arrest, and likewise expiration, the latter particularly during deep narcosis. The blood pressure rises during pressure upon the eyes. Pressure upon one eye has less effect than upon both. In the exposed heart the slowing of the rhythm with evident decrease in the size of the contractions is visible and if the pressure on the eyes is increased sufficiently, the heart can be arrested in diastole.

Aschner describes other interesting points brought out in his study. The reflex is more easily obtained in narcosis than in patients who are conscious.

Hypophysis Glycosuria and its Relation to the Diabetes of Acromegaly.—

It is now quite generally accepted that in acromegaly there is hyperfunction of the hypophysis, which may be of etiological importance. Since many cases of acromegaly are complicated with diabetes, BORCHARDT (*Ztschr. f. klin. Med.*, 1908, lxi, 332) considers it possible that the latter may be due to the same cause. To test this hypothesis he has injected extracts of the hypophysis subcutaneously in rabbits. The extract was obtained from the hypophysis of man and the horse. In each animal used, following the injection of a rather large dose of extract, glycosuria occurred. The amount of sugar varied from a trace to 4.2 per cent., the glycosuria being transient and seemingly independent of the size of the dose of extract. In two animals hyperglycemia was demonstrated, the blood showing 0.41 per cent. sugar in one instance. In dogs the results were inconstant. Brain extract produced no glycosuria when injected subcutaneously. In reviewing 176 cases of acromegaly in the literature Borchardt finds diabetes in 35.5 per cent. of cases. The pancreas was normal histologically in most of the cases examined. Borchardt thinks his experiments make it probable, although by no means certain, that the diabetes of acromegaly is to be explained by hypersecretion of the hypophysis cerebri.

The Thymus in Basedow's Disease.—CAPELLE (*Münch. med. Woch.*, 1908, lv, 1826) has interested himself in the question of sudden death as a result of operation in cases of Basedow's disease. Some have ascribed death to the narcosis, others to a certain flooding of the blood with the products of the thyroid gland. But the use of cocaine anesthesia has been followed by death, and, indeed, the simple tying of the arteries has resulted fatally. A study of the literature shows that enlargement of the thymus is found in fatal cases with great frequency. Capelle finds that of 60 cases (autopsy), 79 per cent. showed a hypertrophic thymus. The operative and postoperative fatal cases had in every instance an enlarged thymus. The investigation suggests: (1) That the thymus is not necessarily enlarged in Basedow's disease. (2) That its enlargement is clinically a good indicator of the severity of the case. (3) That the deaths from heart failure after operations are, in reality, thymus deaths. Cases which show a persistent enlarged thymus should not be subjected to operation.

Salt Metabolism in Experimental Nephritis.—SCHIROKAUER (*Ztschr. f. klin. Med.*, 1908, lxi, 182) has produced nephritis in rabbits by administering uranium nitrate and potassium chromate. Severe kidney lesions were obtained, often accompanied by anasarca. Quantitative analysis of the phosphates, chlorides, and sulphates give the following results: In nephritis with generalized oedema one finds an increased water content of the organs (muscle, liver) as a manifestation of the general retention of water. With this there is also found augmentation of the total salts of the organs which is ascribed essentially to the retention of chlorides. The phosphates are not increased in the muscles, but in the

liver the quantity is variable, being above normal occasionally. The sulphates of the muscles are within the normal limits. In the blood, however, the findings are different, the total ash showing a definite, though slight, diminution. The phosphates of the blood remain normal, while the sulphates in animals poisoned with uranium are abnormally high.

Graphic Studies of the Percussion Note.—MAY and LINDEMANN (*Deut. Arch. f. klin. Med.*, 1908, xciii, 500), in their studies upon the tympanitic and non-tympanitic percussion note, have carried out numerous experiments from which they draw the following conclusions: The tympanitic note is characterized by the uniformity of its vibration form. The tympanitic note of the abdomen arises chiefly from one kind of vibration, the ground tone (*Grundtöne*), which is very closely related physically to the pure tone. Additional vibrations are often found, but only in the form of harmonic overtones. As yet their determination has only revealed the first overtone. The non-tympanitic note, on the contrary, shows as its characteristic feature a complicated form of vibrations with very unequal oscillations.

Observations in Experimental Anemia.—MORAWITZ and PRATT (*Munch. med. Woch.*, 1908, lv, 1817) have found in the course of their investigations some interesting phenomena in experimental anemia of rabbits. In cases of pyrodin anemia they have noted the well-known fact that the animals soon became tolerant to the poison. This they have shown to be due to increased resistance of the red blood cells as manifested toward various hemolytic agents, such as sodium chloride solutions of different strength, alkalies, saponin, chloroform, ether, and hemolytic sera. They have obtained practically the same results with washed corpuscles. Therefore the increased resistance is not a property of the serum. In rabbits made anemic by repeated venesections no increase in the resistance of the erythrocytes is found, but when laked blood is injected intraperitoneally the resistance is increased, showing that the increased resistance is not wholly the result of the pyrodin. Four to six days after discontinuing injections of pyrodin the heightened resistance is lost. From the studies of others with human blood, *i. e.*, the finding of increase in the resistance of the corpuscles in pernicious anemia as the condition of the patient grows worse, they think it possible that some prognostic conclusions might be obtained from the study of resistance in this disease. In rabbits made anemic both by pyrodin and by venesection they find a remarkable oxidation that is not found in the normal blood. They believe the phenomenon is due to the presence of incompletely oxidized products of metabolism in the blood. Experiments have shown that the property exists in the serum, not in the red blood cells.

On Sensation to Pain in the Gastric Mucosa.—SCHMIDT (*Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1908, xix, 278) has made some observations on man which are of considerable interest in connection with the pain associated with hyperchlorhydria. In three patients on whom gastrotomy was performed he introduced solutions of hydrochloric acid into the stomach; 20 to 40 c.c. of 0.5 per cent. and 1 per cent. hydrochloric acid were used. They were given the acid about three hours after a

light breakfast, and psychic factors were avoided by keeping the patients in ignorance of the purpose of the experiments. None of the patients complained of the slightest pain or discomfort. Two patients died with malignant disease, and autopsy revealed perfectly normal gastric mucosæ. The experiments show, Schmidt concludes, that with normal gastric mucosa no sensation of pain is elicited from the presence of high HCl values in the stomach.

The Absorption of Uric Acid by Cartilage.—Almaga showed that the addition of cartilage from the horse to solutions of uric acid led to diminution in concentration of the solutions after they were allowed to stand for some time, owing to the fact that cartilage possesses the power to absorb urates from solution, and to store it up in crystalline form. BRUGSCH and CITRON (*Ztschr. f. exp. Path. u. Therap.*, 1908, v, 401) have repeated Almaga's experiments, as they seemed of great importance in gout, since the constant presence of uric acid in the venous blood of the arm has been demonstrated, even when the patient is on a purin-free diet. They were able to confirm Almaga's results in every particular, and then performed the same experiments, using human cartilage in place of horse's cartilage. Cartilage from the ribs and knee of an adult and from the knee of a child were used, the experiments numbering five in all. The cartilage was cut into small pieces and added to solutions of sodium urate of known strengths; some toluol was then added and the whole placed in the incubator at 37° C. for fourteen to twenty days. Subsequent analyses showed that the solutions were markedly less concentrated, and the cartilage had absorbed urate in each experiment. Sections of cartilage examined microscopically, showed the typical urate crystals as in a tophus. It is, therefore, demonstrated that human cartilage possesses the same absorption power for sodium urate as cartilage from the horse. No difference in the absorptive power was found in the cartilage taken from the child and that from the adult, nor did cartilage from the rib differ from that from the knee. Consequently Brugsch and Citron conclude that human cartilage in general is capable of absorbing sodium urate. They proved also that this ability to absorb uric acid is manifested in weak urate solutions as well as in strong solutions. They were unable to find any evidence in their experiments to support the view held by some that tophi result from precipitation of urates from the blood. Kionka has recently made the statement that many acid substances, such as glyco-coll, leucin, alanin, and allantoin, accelerate the precipitation of uric acid from solutions. It remains to be demonstrated to what extent these bodies are present in the blood in gout; it is, however, well known that the blood of gouty patients is by no means saturated with uric acid. Brugsch and Citron have tested Kionka's views experimentally in the following manner: Four preparations of horse's cartilage in weakly alkaline sodium urate were made. To the first alanin was added; to the second leucin; to the third tyrosin; and the fourth was kept as a control. All the preparations were put in the incubator for five days. Analyses made at the end of this time showed the usual absorption of the urate in the control; in none of the other specimens had the slightest absorption occurred. Therefore, so far as one may judge from experiments in vitro, the amino acids are negligible in tophi formation.

SURGERY.

UNDER THE CHARGE OF

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Primary Suture in Gunshot Wounds of the Lung.—KÜTTNER (*Deut. Ztschr. f. Chir.*, 1908, xlv, 1) compares the results obtained in three cases of gunshot wounds of the lungs: one operated on under negative atmospheric pressure in a Sauerbruch cabinet, and the other two treated by conservative non-operative methods. In the first case the bullet had entered in the region of the breast and the patient was soon seized with severe dyspnoea. On his arrival at the hospital the internal hemorrhage had evidently ceased, but during the night it began anew and continued until the following morning when he was operated on. Under negative atmospheric pressure the thorax was widely opened, when a stream of blood as thick as the arm escaped through an opening in the pleura. The lung immediately expanded and the general condition improved at once. After some search and widening of the opening in the chest wall, the wounds of entrance and exit in the lung were found and closed by sutures of silk. The lung filled out close to the chest wall, and the chest wound was sutured without drainage. Primary healing followed and the patient left his bed on the eleventh day. The most striking feature was the great change for the better in the condition of the patient at the end of the operation. He left the hospital cured on the twenty-sixth day. In the two other cases the wounds were much less dangerous, yet the results of the conservative treatment were far less favorable. One developed an empyema, for which not only was a resection of a rib done, but later a thoracoplasty. The other patient had a long convalescence, as is the result in so many cases, during which both the physician and the patient were in doubt and fear as to the ultimate result. This patient was kept in the hospital seventy-eight days and then was discharged with much deformity and in a much weaker condition than the patient operated on. Küttner could find in the literature only 5 other cases of gun-shot wound of the lung treated by primary suture. He believes that we should operate under differences in the atmospheric pressure upon the most severe, even hopeless cases of gun-shot wounds of the lung, for the purpose of directly attacking the bleeding points. He would not drain for persistent hemorrhage, but after the lung has been distended under negative pressure, he would close the chest cavity air-tight, because this aids the control of hemorrhage and the favorable course of healing. When the chest cavity is once opened for a severe primary hemorrhage, the lung wounds should be sought by all methods. Lung wounds should be tamponed only when the far more secure method of ligation or suture is technically impossible.

Removal En Bloc of Epithelioma of the Penis.—MAUCLAIRE (*Archiv gén. d. chir.*, 1908, 11, 247) says that in the treatment of cancer we should practice wide removal of the growth and should, as far as possible, avoid inoculating the wound surface during the operation. The latter object is best attained by trying to remove en masse the infected glandular area and the tumor. Mauclore did the following operation for cancer of the penis: An antiseptic compress was wrapped about the end of the penis to protect the operative wound from infectious or neoplastic contamination. In the first stage he dissected the skin over the right inguinal region with the underlying connective tissue and the lymph glands down to the aponeurosis and femoral vein, in a triangular area, inward to the pubic symphysis. The second stage consisted of a similar procedure on the left side. In the third stage he made a transverse incision three fingers' breadth above the root of the penis. In raising the skin and connective tissue here a small gland may be encountered. In the fourth stage all the tissues of the penis are divided from above downward, including the lateral portion of the scrotum, so that all the lymphatics passing in this region shall be removed. All the tissues removed are thus in one piece. After ligating the bleeding points the suprapubic skin and that of the scrotum are brought together and sutured to the stump of the penis. The urethra is easily divided and separated, and its lateral margins everted and sutured to the skin of the scrotum. The margins of the rest of the wound are then brought together by sutures; a catheter is left in the bladder and dressings applied to the wound. Epithelioma of the penis is often developed from warts, plaques of leukoplakia or a phimosis. Its evolution is generally very slow. Lymphatic involvement is irregular as to its location and extent. There may be from the beginning cancerous involvement of the inguinal and iliac glands. Therefore, we should remove early, and in mass, the tumor and the bilateral lymphatic region. The removal should be wide in order to increase the chances of passing the infected territory and avoiding operative grafting of the cancer.

The Various Forms of Puerperal Mastitis and Their Treatment.—FEINEN (*Deut. Ztschr. f. Chir.*, 1908, xclv, 357) quotes and seems to agree with Fleck in the statement that there is no longer any doubt that mastitis is almost always due to the penetration of bacteria, by the lymph paths, from abrasions or fissures of the nipple. The bacteria are chiefly staphylococci; more rarely streptococci; in a few cases gonococci, typhoid bacilli, micrococcus, tetragenus, colon bacilli, etc. The infection occurs generally in from the second to the fourth week. Broucha reported one case in which it developed twelve hours after birth. The forms of mastitis are classified into four groups: very acute inflammations, mammary abscesses, interstitial or parenchymatous mastitis and the gangrenous form. To these may be added the tubercular. The clinical features of the acute inflammatory, the abscess, and the gangrenous forms are too well known to require special attention. The correct diagnosis of the interstitial or parenchymatous is more difficult. When only a part of the gland is diseased and the inflammation is visible in the skin only through a doughy swelling, and in the deeper part a diffuse hardening with no fluctuation is felt, and when in consequence of the radiating arrangement of the ducts and lymphatics of the gland, the

inflamed area is broad at the periphery and gradually narrows at the nipple, the diagnosis of the interstitial or parenchymatous may safely be made. In such cases there is not a total melting away of the interstitial connective tissue, nor a confluent abscess formation. It presents the picture of an intracanalicular mastitis. Feinen sums up the treatment of the different forms as follows: In cases of early inflammations the antiphlogistic treatment is best. This consists in placing the affected breast mechanically and functionally at rest. The child is weaned, the milk is not withdrawn, and a purge is given. The breast is fixed to the thorax and moist dressings applied. In from two to four days the inflammation subsides. In cases of circumscribed mammary abscesses a small incision into the abscess and suction by cupping, according to the Bier method, gives the best results. In cases of interstitial mastitis, the new operation of Bardenheuer, gives the best results. This consists in raising the breast by an incision along its lower border. The whole gland is separated from the pectoral fascia. The abscesses are then incised and drained from the posterior surface, and the wound surface cleansed of all infected tissue. It heals by granulation. Only a single operation is required and this is simple and exact and gives the best cosmetic result. There is no scar on the surface of the breast, and only a linear scar at the lower border, which is obscured by the overhanging breast. The remaining gland tissue preserves its function and only the diseased tissue is removed. Finally, because of the small amount of scar tissue, it offers the least probability of cancer formation. In the gangrenous forms the simple removal of the gangrenous parts is advised. In all cases of puerperal, tuberculous mastitis, amputation is the only treatment considered.

The Gleich Operation and its Results in the Therapy of Flat-foot.—FRISCH (*Archiv f. klin. Chir.*, 1908, lxxvii, 324) describes the Gleich operation as performed in Eiselberg's clinic as follows: An oblique incision, a finger's breadth above the external malleolus, divides the skin, subcutaneous tissue, tendo Achillis and periosteum of the calcaneus. The margins of the wound are retracted with sharp hooks and the tuberosity is chiselled through, with as smooth a surface and as little splintering as possible. The periosteum on the far side of the bone wound is divided with a sharp knife in order to obtain free mobility of the separated piece of bone. This is displaced downward about the thickness of the small finger and slightly inward. If in any case the valgus position is especially marked, this lateral displacement of the tuberosity should be somewhat more marked. How far forward the fragment may be pushed will depend upon the angle of the chiselled surface. If this is in the right direction, as the fragment is pushed downward it may also be displaced anteriorly. While it is being held in the desired position it is fixed by a nail driven from the summit of the tuberosity through the fragment into the body of the calcaneus. The operation can be done aseptically throughout, and after the proper skin sutures are introduced and dressings applied, a plaster bandage may be put on without drainage. Frisch recommends this operation for severe cases, because of its simplicity and permanent results. The support of the arch will be so changed by the alteration in the position of the tuberosity of the os calcis, that the anterior or chief end of the

arch will be relieved and the lateral deviation diminished. By the displacement forward the leverage action of the tendo Achillis will be more advantageous. By the downward displacement the short plantar muscles produce an increase in the convexity of the plantar arch. The correction of the valgus position is obtained by the displacement of the tuberosity inward. A few months are necessary before the patient can walk or stand. The wearing of a brace or splint after the operation will not be necessary as the improvement is spontaneous.

Two Cases of Gallstone Ileus; Operation; Recovery.—NEWBOLT (*Lancet*, 1908, clxxv, 797) says that the diagnosis was not made in either of his two cases before operation. The fact that the obstruction is a mechanical blocking of the bowel and that those symptoms depending upon a direct interference with the vascular supply are absent, may help us in the diagnosis. In both cases the stones were found in the small intestine not far from the ileocecal valve. They were both nearly of the same size. The first measured two inches in length, one and one-half inches in diameter, and three and one-half inches in circumference; and the second was only one-quarter of an inch smaller in each dimension. Each stone had a constriction at the end nearest the duodenum, and in one case the stone was fractured at this constriction. What impressed Newbold most was the unfamiliar type of the symptoms of obstruction in both cases. Some days after the beginning of the attack, neither of the patients looked as ill as one would have expected and the soft though distended abdomen with the absence of tenderness on pressure, was most marked. A stringent cross examination failed to elicit any history of gallstones even after operation.

Notes on 679 Operations Performed under Spinal Anesthesia (Cocaine or Stovaine) by Tuffier's Method.—SABADINI (*Lancet*, clxxv, 1213) says that the early contributions of Corning, Tuffier, and others had established the fact that the introduction of cocaine into the spinal column produced widespread anesthesia without circulatory or respiratory disturbances, and that cocaine determined no grave changes in contact with the nerve elements. Sabadini's 679 operations included a large variety of laparotomies and operations on the limbs. They were always below the level of the umbilicus, the anesthesia extending upward as a general rule to within two fingers' breadth below the breasts. Yet he removed three mammary cancers by this method and did a resection of the elbow. The dose in these 4 cases was 3 cg. for the first 3, and 4 cg. for the fourth. To insure diffusion of the cocaine the patient was kept in the Trendelenberg position for ten minutes after the injection, but anesthesia was incomplete in each case and chloroform was added. He has not repeated the experiment. The number of failures was about 11 per cent., and they were probably due to idiosyncracies or to the fact that the anesthetic dose varies with the individual. The subjective phenomena occurring between five and fifteen minutes after injection are such as pallor, sweating, nausea, vomiting, and occasionally but rarely marked apprehension. Epileptoid tremors of the lower limbs and fatal syncope may develop. The frequency of nausea and vomiting has been reduced 50 per cent. by giving the patients their breakfast before making the injection. Sabadini has had no case of

fatal syncope. He recognizes the following contra-indications to this method of anesthesia: Advanced cachexia, bilateral nephritis with scanty urinary secretion, myocarditis, pericarditis with effusion, and non-compensated cardiac affections. These absolutely prohibit the use of cocaine. The only two untoward consequences at a later period have been headache and rachialgia. All accidents that occur are to be ascribed to a defective technique and not to the method per se. The only real drawback to the method is that in certain nervous and alcoholic subjects the anesthesia is not complete. It may be employed in patients from ten to fifteen years of age up to extreme old age. Although stovaine was not given a satisfactory trial, on the whole the advantages appear to be in its favor.

A New Method of Sterilizing the Skin for Operations.—GROSSISCH (*Zent. f. Chir.*, 1908, xxxv, 1289) has had a large experience in the treatment of wounds resulting from accidents. These are frequently difficult to render aseptic, especially when they involve the hairy part of the scalp, neck, axilla, or scrotum, or the fingers and toes. In his first case Grossisch painted the surface of a broad lacerated wound and the surrounding skin with the tincture of iodine without any washing. He sutured the wound completely, coated the sutures with the iodine and applied the usual sterile dressing. Healing by first intention followed. This method has since been repeated many times with the same result, provided there was already no preceding sign of infection of the wound. When a preliminary cleansing of the wound and surrounding skin by soap and water was made, the healing was not so favorable and points of suppuration developed here and there. This method was later applied to small operations, the hair being first shaved dry, and the field of operation then covered with the tincture of iodine. Perfect healing by first intention was usually obtained. Microscopic examination of a piece of skin treated by iodine showed that the iodine had penetrated into all the clefts and spaces and lymph radicles. This capacity for penetration is due to the alcohol present. Water or watery solutions penetrate only incompletely and superficially. Grossisch has used this method in operations for free inguinal and femoral hernie and incarcerated inguinal. All healed without any disturbance. The method has also been employed successfully in other major operations. The same scrupulous care must be observed in cleansing the hands, instruments, and dressings, as in operations by the usual methods.

Compensatory Re-arrangement of the Space in the Chest Cavity after Amputation of One Lung, together with Observations on Operative Mediastinal Emphysema.—FRIEDERICH (*Archiv f. klin. Chir.*, 1908, lxxxvii, 647) says that mediastinal emphysema may become a fatal complication after operation on the lung, especially when the operation invades the lung near the hilus and when the opened bronchus has not been closed properly. Seven days after amputation in the pneumatic cabinet of the lung of a dog, when the recovery was progressing favorably, the dog suddenly began to fail and to develop a subcutaneous emphysema over the chest. This progressed rapidly and extensively, and the dog died in six or seven hours. Postmortem examination showed beside the general subcutaneous emphysema, interstitial emphysema along

the deep muscles of the neck, enormous emphysema of the mediastinum, pericardium, and the whole retropleural, peripleural, and retroperitoneal tissue. At the right hilus there was found a loosened ligature, which had been applied to a divided bronchus, and this bronchus had retracted inward into the mediastinal space. Opening of the chest in the pneumatic cabinet, with resulting removal of the air, might have overcome the indirect effect of the mediastinal emphysema on the circulation and respiration. An almost analagous case is reported by Friederich, following removal of the left lung in a woman, but in this case the autopsy did not reveal the source of the escaping air. A septic pleurisy also developed in this case. In those animals in which the amputation of the lung had been done and the ligature had been effective in maintaining the closure of the bronchus, and the asepsis was good, the operation was quickly and effectively carried out, and no symptoms of inflammation developed. The animals lived, were active, had good appetites, and increased in weight. This shows that the remaining organs adapt themselves to the altered relations rendered necessary by the vacant space left by the removal of the lung. This is brought about by a change in position of the soft tissues and a sinking in of the ribs on the side operated on, so that the space vacated by the removed lung becomes obliterated. This is well shown by the illustrations of specimens from dogs operated on and later killed. Absolute healing may thus follow the removal of one lung. The defect becomes filled, by the displacement of the heart and mediastinum toward the affected side, by vicarious emphysema of the remaining lung, by ascent of the diaphragm, and by flattening of the ribs on the affected side.

THERAPEUTICS.

UNDER THE CHARGE OF

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Vaccine Therapy and Therapeutic Immunization.—WRIGHT (*Practitioner*, 1908, vi, 565) reviews the conclusions which have been established by his own results in vaccine therapy and auto-immunization and by those of his fellow workers. These conclusions are the following: (1) Vaccine therapy is applicable not only to localized infections, but also to general septicemic diseases. (2) Spontaneous auto-inoculations occur not only in general septicemic diseases, but also in cases with localized diseases in which the focus of infection has attained to a certain development. (3) Auto-inoculation can, in the case of localized disease, be artificially induced by massage, by active and passive movements, and by active and passive hyperemia. (4) Such artificially induced auto-inoculations can be turned to useful account in diagnosis. (5) The success of certain empirical methods of treatment,

notably the Bier method of passive congestion, is probably largely dependent upon the fact that it induces adequate and not excessive auto-inoculations. Wright further considers the possibility of achieving the desired improvement apart from the determination of the opsonic index. There is associated with this point the question as to whether the technique used for the determination of the opsonic index gives accurate and useful results. He is of the opinion that injections of bacterial vaccines should not be undertaken entirely in the dark. He believes that both vaccines and the human organism are too variable and inconstant factors to allow even an approximation to the fixing of a definite dose applicable to all conditions. In dealing with vaccines, one can never leave out of consideration the difference in different strains of the same organism. Some minute difference in the mode of preparation, or perhaps some change occurring spontaneously during preservation, might affect the strength of the vaccine products. But a greater factor exists in the different effect produced by the same dose of vaccine in the healthy individual as compared with that in the infected patients, and in the cases of severe infection as compared with the result in those of light infection. Thus, when it is difficult to predict the result of one inoculation, it is much more difficult to predict the result of a series of inoculations. In a few individual cases a proper dose may be arrived at which will give uniform results. This is true in strictly isolated local infections, such as a furuncle. When one adheres to a given dose, there is a possibility of two errors. The doses might be too small, and have little or no effect, or, on the other hand, they might excite a marked negative phase and so do much harm. In taking up the suggestion that the clinical symptoms of the patient may furnish a guide, he considers four classes of cases. There are cases of localized infections which the clinical observer can see for himself and learn of every change which occurs in the focus of infection. The most typical examples of these are furunculosis, sycosis, and suppurating acne which are usually due to staphylococci. In the same class there are the streptococcic infections of the skin and subcutaneous tissue, which take the form of impetigo, serous furuncles, erysipelas, and lymphangitis. He also includes in this class infections of any organ in which by examination of secretions or excretions one may obtain an idea of the inflammatory process.

With the subjective symptoms as a guide in such cases, and with such objective signs as we can elicit, we may judge whether the dose has been moderate, small, or excessive. An improvement for a brief period followed by an early relapse would indicate too small a dose. If the patient grew immediately worse, we would assume an excessive dose. He points out some errors, however, which may result if too great dependence is put on clinical symptoms: (a) The clinical symptoms may convey quite an erroneous idea of the real conditions of the local infection. This is true in mixed infections, in which incidentally the secondary infection may increase in extent and obscure the clinical picture. (b) The clinical symptoms of the local infection may give an entirely wrong idea of the general infection. (c) The anti-bacterial power of the blood of a patient in good, general condition cannot be assumed to be at all uniform.

There are cases of strictly localized infection in which the process is

more or less chronic, in which the information indicating an advance in the process as given by clinical signs and symptoms is often too late. This class comprises cases of tuberculous adenitis or arthritis, phthisis, and lupus. In acute febrile conditions the general rule, that with the subsidence of the temperature the protective substances increase, has many exceptions. Finally, there is the class of cases in which all local and general symptoms are in abeyance. This class includes cases of the other groups which are apparently cured. Wright claims that the important question relative to the establishment of immunity can be answered in all cases only by a determination of the opsonic index. He believes that the technique for the determination of the opsonic index furnishes accurate and useful information with respect to the patient's progress. He explains the inconsistent results of other observers either by faulty technique, in the necessary mechanical manipulation, or by lack of required patience.

Wright mentions a number of therapeutic measures which bring the antibacterial agencies of the circulating blood into effective operation upon the microbes at the site of infection.

Among the measures are active and passive hyperemia. He believes their beneficial effects are produced by auto-inoculation. Active hyperemia may be induced by hot fomentations, rubefacients, or heat in any form. Passive hyperemia is usually obtained by the well-known method of Bier. Wright says that diminished coagulability of the blood is associated with increased transudation of lymph, while increased coagulability leads to a diminished transudation of lymph. He believes also that calcium salts, especially the lactate, have the power to increase the coagulability of the blood, and that citric acid diminishes it. Thus, he thinks it possible to hasten the absorption of a transudate by giving calcium lactate or to secure an effusion of serum by the use of citric acid. He points out the advantage of determining a flow of lymph rich in anti-bacterial power to the infected area. For this purpose he advises the use of wet dressings of one and a half to four parts of salt and one part of citrate of sodium dissolved in 100 c.c. of boiling water. The surrounding skin should be protected by vaseline to prevent excoriation. He considers that the various surgical procedures of evacuating abscesses are all means to an end, the means of bringing the antibacterial agencies of the blood into effective operation. Therefore, he believes in early incision, before the formation of pus.

A Specific Ferment Therapy for Diabetes.—ZUELZER (*Ztschr. f. exp. Path. u. Therap.*, 1908, v, 306) showed in a previous paper that in experimental animals injection of a pancreatic extract prevents the production of adrenalin diabetes. In this communication Zuelzer gives the results obtained by the injection of the extract in experimental diabetes due to extirpation of the pancreas and in diabetes in man. The extract was prepared from pancreatic glands taken from animals at the height of digestion. The animal experiments were few in number, but the results obtained were quite constant, that is, diminution of the quantity of sugar excreted in the days following the injection. The experiments on animals were interrupted by an opportunity to try the extract in man, and had not been completed at the time of publication. The first human patient was a man, aged fifty years, in whom diabetes

had been discovered three years previously. On strict diet the sugar amounted to 6 per cent. Following amputation of the left leg for gangrene, acidosis with coma developed and the patient's condition was desperate. Accordingly, he was given a subcutaneous injection of 3 grams of pancreatic extract dissolved in 8 c.c. of water. On the following day a second injection containing 5 grams was given. The urine was lost during the days subsequent to the injections, but there occurred a marked improvement in the general condition of the patient, especially in his mental condition. Seventeen days after the first injection was given the patient died, before a fresh supply of extract could be obtained. The results demonstrated, however, the apparent harmlessness of the extract. The second patient was a man, aged twenty-seven years, admitted to Prof. Kraus' clinic six months after the diagnosis of diabetes had first been made. The amount of urine varied between 1400 and 3000 c.c., sugar between 2 per cent. and 6.4 per cent., and acetone and diacetic acid were constantly present. Following the first small injection (1 c.c. intravenously) the sugar fell to 1.3 per cent. in 1400 c.c. of urine, acetone, and diacetic acid being present. The second injection was larger, containing 2 grams of extract. Acetone and diacetic acid completely disappeared from the urine on the next day, and the urine contained neither of these substances for three days; glucose gradually diminished until only a trace was found on the third day after the second injection. Subsequently the sugar gradually increased in quantity and diacetic acid and acetone reappeared. Further observations in this case were impossible, as the patient left the hospital. In six other diabetics between six and sixty-five years of age, injections of pancreatic extract were tried, and in all the results were uniform and constant (except in a few instances in which inactive extract was demonstrated), the glucose always being diminished and usually entirely absent from the urine in two to three days after the injection, the same also holding good with acetone and diacetic acid. On several occasions the injections were followed by chill, rise in temperature, and, less often, by a stomatitis, the symptoms passing off in one to two days. In all the experiments no change was made in the diet of the patients after the injections. In the future Zuelzlor proposes giving smaller doses at more frequent intervals, hoping thus to avoid the unpleasant consequences. His conclusion is that it is possible to cause sugar, diacetic acid, and acetone to disappear from the urine of diabetics by the injection of pancreatic extracts. To what extent this fact may be utilized therapeutically remains to be determined.

The Treatment of Diphtheria, Scarlet Fever, and Tonsillitis by Pyocyanase.—SAUER (*Deut. med. Woch.*, 1908, xxxvi, 1541) has used pyocyanase as a spray in 39 cases of various throat infections. These cases included 14 cases of diphtheria, 8 of the sore throat of scarlet fever, and 17 of severe tonsillitis, 3 of which were cases of Vincent's angina. Every case was diagnosed by a bacteriological examination. Laboratory experiments showed that the preparation had a solvent action upon diphtheritic membrane. The growth of diphtheria bacilli in cultures was in part inhibited, but there was no effect in neutralizing the diphtheria toxin. An ordinary throat spray was used and the throat was sprayed with the solution three to four times a day. For a half hour

after the spraying the patient must not gargle. The throat may be sprayed through the nose when necessary. Children soon get accustomed to its use. Clinically Sauer observed a rapid diminution of the diphtheritic membrane, with a rapid disappearance of the diphtheria bacilli from the throat. The sore throat of scarlet fever was rapidly relieved and the membrane disappeared in three to four days. Vincent's angina was cured in from two to three days. Cases of ordinary tonsillitis rapidly improved, both as regards the disappearance of the membrane and the subsidence of the fever and general symptoms. He does not believe that pyocyanase can take the place of diphtheria antitoxin, although it may be a useful adjuvant in the treatment of diphtheria. It may also allow the use of smaller doses of antitoxin than are usually thought necessary.

The Treatment of Tetanus by Means of the Local Application of Lipoid Substances.—BROCKENHEIMER (*Archiv f. klin. Chir.*, 1908, lxxxvi), in his investigations of this subject, has taken advantage of the known power of some lipoid bodies to bind toxins. This fact is notable in the case of snake venoms which are bound by cholesterin and of botulism toxin, which act similarly with other lipoid bodies. The fats used by the author were olive oil, cod-liver oil, liquid paraffin, vaseline, and a salve of Peruvian balsam. The experimental research was conducted on guinea-pigs, which are quite susceptible to tetanus, and the inoculations were made so as to approximate the conditions of infection in man. The fats were applied to the area of infection. The best results were secured with Peruvian balsam salve, which prolonged the period of incubation to twice that of control animals, and caused the tetanus when developed to appear less virulent than in the controls. Brockenheimer reviews the cases of tetanus occurring in von Bergman's clinic for the last twenty-five years. There have been in this period 29 cases of tetanus, with a mortality of 86.2 per cent. Of 20 cases treated by means of antitoxin, 3 recovered, and in these 3 the period of incubation was prolonged, allowing a more efficient antitoxin treatment. Brockenheimer considers the proper treatment of wounds suspected to be infected with tetanus: (1) Cleansing and washing out with hydrogen peroxide, since this checks the growth of tetanus bacilli. (2) Applications of Peruvian balsam salve to delay the incubation period. (3) The daily use of antitoxin during the doubtful period. Amputation is advised in the cases of local tetanus which develop in the first two weeks after injury.

The Treatment of Gout.—L. A. AMBLARD (*Arch. gén. de méd.*, 1908, lxxxviii, 411) gives in detail a review of the recent advances in the treatment of gout, especially as regards the dietetic régime necessary for the best results. After a thorough review of the literature he is inclined to believe that the uric acid is most probably kept soluble by the action of thymic acid, hence the importance of the use of this latter agent therapeutically. As high temperatures destroy the combinations of this acid with the purins, rare meats are more desirable than those well cooked. Food stuffs, poor in purins, should be given as much as possible (these may be found in Hall's dietetic tables accompanying the article). White meats contain nearly as much purins as dark meats,

as do also beans and oat meal, so that the best articles of diet are milk, butter, fresh cheese and eggs, and possibly a little red meat each day. As regards the medicinal treatment the wine of colchicum is of most importance in the acute cases, many other drugs being used during the course of the disease for their supposedly dissolving effect on the uric acid; these are the various alkaline drugs—salicylates, piperazine, aspirin, and thymic acid, which latter Amblard advocates on account of its soluble action on the uric acid. Finally the free use of mineral waters and of exercise are of the utmost importance.

PEDIATRICS.

UNDER THE CHARGE OF

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Spontaneous Hemorrhage from the Ear Terminating in Death.—H. HALASZ (*Archiv f. Ohrenheilk.*, 1908, lxxvi, 78) reports the case of a child of two weeks, born at seven months, which died after bleeding from the right ear, the hemorrhage extending over a period of eight days. Such cases are extremely rare and in most instances are preceded by a suppurating condition of the ear. There are but 2 cases (his own being one) in which no such illness preceded the hemorrhage. At first the blood came from the ear, flowing but slowly with occasional cessation of one or more hours. After a few days a sausage-shaped mass developed at the right side of the neck, which ruptured, with the result of blood escaping from this wound also. About this time the child became jaundiced. The mass mentioned was three inches long, the size of the middle finger, hard, not pulsating, and the blood escaping from it as well as from the ear was dark red. No operation was permitted and death occurred on the eighth day. In the absence of an autopsy the cause of the bleeding could not be accurately determined. The bleeding was evidently venous—jugular vein or transverse sinus—as proved by the slow flow, the dark color, and the absence of pulsation in the mass, which latter was probably the thrombosed jugular vein. The cause might have been syphilis, tuberculosis, acute yellow atrophy, or leukemia.

Congenital Dislocation of the Hip Treated according to the Method of Lorenz.—VAN DEN BERGH (*Ann. et bull. de la soc. de méd. d'Anvers*, 1908, lxx, 17) reports 15 cases of congenital dislocation of the hip, 7 of which were right-sided, 3 left-sided, and 5 bilateral. Fourteen of the patients were girls and one a boy. Three were less than two years old; 2 of these were still under treatment, while the third died of meningitis, two and one-half months after the reduction; 4 were three years old and 3 of these recovered, the last remaining without improvement; 1 of these cases was operated on ten years ago; 1 at four operated

on four years ago remains well; 3 were operated on at five, with two known good results; the third was lost sight of; 1 patient at six was not improved; 1 at eight and 1 at eleven were cured; another at eleven was made somewhat better. Van Den Bergh has not had radiograms made to control his good results, of which there were 8 in all, and thinks that in several cases the head was fixed in anterior luxation, but with perfect and permanent functional result.

Examination of Eyes in the Schools of Brussels.—P. DE RIDDER (*Ann. d'ocul.*, 1908, cxi, 27) has examined the eyes of 2820 children of the schools of Brussels. Between six and eight years there were 835 children; 353 (42 per cent.) had abnormal vision; 197 (23 per cent.) were hypermetropes; 48 (5.5 per cent.) myopes, and 83 (10 per cent.) had astigmatism. Between nine and ten years there were 869 children examined; 333 (40 per cent.) had abnormal vision; 172 (19 per cent.) had hypermetropia, 74 (8.5 per cent.) myopia, and 69 (8 per cent.) astigmatism. Between the ages of eleven and twelve, 735 children were examined with 316 (42 per cent.) of abnormalities; 156 (21 per cent.) had hypermetropia, 80 (10 per cent.) myopia, and 61 (9 per cent.) astigmatism. Of 376 children between the ages of thirteen and fourteen examined, 208 (44 per cent.) were found to have abnormal vision; 85 (22 per cent.) of these had hypermetropia, 69 (18 per cent.) myopia, and 45 (12 per cent.) astigmatism. In all there were 607 (21.5 per cent.) hypermetropes, 289 (10 per cent.) myopes, and 272 (9 per cent.) astigmatics. It can be seen from this that hypermetropia and astigmatism are not increased by the work of the schools, but in myopia the proportionate increase is quite marked, this being due directly to the school studies; the same condition is reported from other parts of the world. He concludes from this, that the eyes of all the scholars should be examined, and means to correct their vision devised; on account of the gradual development of myopia the surveillance should be continued throughout the school years to note the appearance of visual alterations; as the scholars quit school they should be advised as to the best line of work for them to take up.

Hemorrhage after Excision of the Tonsils.—Fatal hemorrhage after tonsillectomy or adenoid operations is very rare, and when occurring it may be immediate (connected probably with the operation) or secondary. The former is due usually to injury of the neighboring vessels, the latter to hemophilia, although this disturbance may be the cause of immediate hemorrhage also. HAYMAN (*Archiv f. Laryng. u. Rhin.*, 1908, xxi, 15) reports the case of a boy of fourteen, in whom all three tonsils were removed because of frequently recurring violent attacks of tonsillitis. He had always been a perfectly healthy boy, and there was no history of hemophilia in the family. In earlier years he had been operated on for adenitis without appreciable hemorrhage, and the only thing known to call attention to the disturbance lay in the fact that light injuries to his fingers always resulted in prolonged and marked bleeding. The operation was not accompanied by especial bleeding and what there was ceased completely within a short time. Two hours later blood trickled into the pharynx from the nose in a steady stream, and could not be checked by ordinary measures; later the pharyngeal

tissue began to ooze also. Hydrogen peroxide and styptic powders did not avail, but after the nose was tamponed, bleeding therefrom was checked for a time. It reappeared again, and in spite of adrenalin, gelatin, suturing of stumps, tamponing of pharynx, and other procedures it continued, terminating in death sixteen hours after the operation. The autopsy showed a perfectly normal state of the internal organs, and careful search did not reveal any injury of the vessels of the neck. Hayman considers this a case of hemophilia, as no other cause could be discovered in spite of careful consideration.

Pretracheal Abscess in a Case of Scarlet Fever.—GIUSEFFI (*Allg. Wien. med. Woch.*, 1908, liii, 373) reports the case of a girl, aged nine months, who had recovered only a short time before from an attack of measles. She was suffering with a sore throat, from the exudate of which many cocci and some few bacilli were isolated. On the third day of the disease the typical scarlet-fever eruption appeared, and with this was noted a disappearance of a slight hoarseness of the voice. The child had high fever for four days. On the tenth day of the exanthem moderate signs of a stenosis were noted, not sufficient, however, to make an operation seem necessary. The child died during the night from a sudden paroxysm of asphyxia. An elastic tumor the size of a walnut was found beneath the sternohyoid and sternothyroid muscles, which when incised was found to contain thick yellow pus. The abscess extended from the beginning of the trachea to its bifurcation without, however, exerting any pressure upon the pneumogastric or recurrent laryngeal nerves or the œsophagus. The right pulmonary apex was the seat of bronchopneumonic foci. The thymus was attached to the lower pole of the abscess wall. *Streptococcus pyogenes* was isolated from the pus in pure culture. This organism had probably entered the pretracheal glands during the attack of measles. Giuseffi has not been able to discover a similar case in the literature, the few he has been able to note being due to intubation trauma, or aspiration of foreign bodies.

Prophylaxis of Umbilical Tetanus at Saigon (Cochinchina).—At the suggestion of R. MONTEL (*Ann. d'hygiène et de méd. col.*, 1908, xi, 72) a maternity was instituted at Saigon in Cochinchina, and the midwives of the district trained in aseptic obstetrics. This was followed within a few years by a reduction in the tetanus mortality from 30 of every 100 deaths to 2.52, and by a fall of the general mortality of the infants less than one month old from 37.33 out of every 100 born to 21.73 (1905), 13.92 (1906), and 10.22 (1907). Cutting the umbilical cord with sterilized scissors and tying it with an aseptic ligature sufficed to prevent the greater number of tetanus infections. A number of other precautions to diminish the general mortality from other diseases (gonorrheal ophthalmia, hereditary syphilis, etc.) has also been taken.

OBSTETRICS.

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Hebosteotomy Compared with Other Procedures in the Management of Labor in Contracted Pelves.—PFANNENSTIEL (*Surgery, Gynecology, and Obstetrics*, October, 1908) has found that hebosteotomy enlarges the transverse diameter of the pelvic inlet on the average 4 to 5 cm., and occasionally 7 cm. The anteroposterior diameter is increased 1 cm., or at most 1.5 cm. The pelvic outlet is enlarged only about 2 cm. in the transverse diameter, and 0.5 in the anteroposterior. A conjugata vera of 8.5 cm. must be present for the successful passage of a normal child. Accordingly, the operation is indicated only when the conjugata vera is 7 cm. or more. In a flat pelvis in which the inlet is contracted, but in which the outlet is large, the operation may be employed with a true conjugate of 6.75 cm. In generally contracted pelves one should not go below the limit of 7.5 cm., because the outlet is also contracted. Lacerations are very apt to occur in such cases from the cut ends of the bone. There is no upper limit to the operation, which may be chosen upon the comparative size of mother and child. It is then of the greatest importance to ascertain this fact in the higher grades of pelvic contraction. Cesarean section is indicated in flat pelves with a conjugata vera under 7 cm., in generally contracted pelves with a conjugata vera under 7.5 cm., and in the case of a very large child, with a conjugata vera of 8 cm. In comparing results of hebosteotomy and Cesarean section, the mother is exposed to about the same risk in both operations, an average mortality of 4.5 per cent. The infant mortality in hebosteotomy is 7 per cent.; in Cesarean section, 1 per cent. For success in both it is important that no previous effort at delivery should have been made, and that the condition of the patient should be absolutely aseptic. If infection has occurred, then both operations should be declined. Version should be avoided after the operation, but the high application of forceps is permissible when infection is absent. This attempt must be made very cautiously, and if the head is not readily delivered then craniotomy should be done. When the patient declines the operation, in flat pelves of moderate contraction, with the child of moderate size, prophylactic version is advised. Induction of labor before the thirty-sixth week, when the head is proportionate to the pelvis, gives good result. If the pelvis is generally contracted, the true conjugate must be not less than 8 cm., and if flat, 7.5 cm. Careful, aseptic technique is necessary, and in flat pelves dilatation with bags, followed by prophylactic version, may be employed. In generally contracted pelves bougies may be used and spontaneous labor encouraged as much as possible. The use of forceps will often be indicated, but the mortality for the children in induced labor varies from 2 to 18 per cent. The operation for the child is less safe than hebosteotomy or Cesarean section. The operation is to be performed by an experienced surgeon only.

Pfannenstiel's method in liebstectomy is as follows: The incision, about 1.5 cm. long, is made on one side in the groove between the labium minus and labium majus. It is parallel to the descending ramus of the pubes, and is made down to the bone. The soft parts behind the pubic bone are separated by an elevator and the fingers. Bumm's needle is introduced from below upward to the tubercle of the pubis, with saw attached, pulled through, and the bone sawed subcutaneously. The wounds above and below are closed with silkworm-gut suture, and the patient is delivered. Spontaneous labor is not waited for to avoid pain and delay. In four cases labor was complicated by prolapse of the cord, and in three by excessive pressure upon the head. When the soft parts are very narrow, Pfannenstiel makes a prophylactic perineovaginal incision on the same side with the incision through the bone. This he thinks prevents lacerations of the soft parts by the bone.

Puerperal Salpingitis.—FRIEDMAN (*Surgery, Gynecology, and Obstetrics*, October, 1908) draws attention to puerperal salpingitis, and describes the symptoms in 21 cases. He distinguishes a gonorrhœal variety and that due to other infections. This disorder usually appears about the third day, with rise of temperature to 102° F. or 103° F. If the infection is limited to the tube, the pulse does not rise in proportion to the temperature. The patient complains of pelvic pain on the affected side, and lies flat with the leg drawn up. There is moderate tenderness on deep pressure. Spasm is usually absent. The lochia are at first normal, then contain pus. If the tube is not closed, and drains, very little pain is present. Three types of this condition may be observed: The first, in which the tube is closed at the peritoneal extremity, but drains into the uterus, pain and temperature are moderate or absent, but the lochia very soon contain pus. When both ends of the tube are occluded the lochia are normal, but pain and temperature are much increased. Occasionally the tube ruptures into the peritoneal cavity. When the uterine extremity of the tube is closed, the peritoneal end open, the temperature high, then peritonitis is apt to develop from the escape of pus into the peritoneal cavity. Both ends of the tube are rarely ever open. When the right tube is affected, then appendicitis may be suspected also. As the prognosis is good, the treatment usually required consists in the administration of codein, and absolute rest. Interference is rarely necessary, but should be undertaken if the case does not promptly improve.

Traumatic Rupture of the Uterus and Bladder during Labor at Full Term; Hysterectomy, Repair of Bladder, and Recovery.—BROWN and SWAHLEN (*Jour. Amer. Med. Assoc.*, October 24, 1908) report the case of a multipara attended in labor at first by a midwife. Later a specialist was summoned, who made an ineffectual attempt to deliver with forceps. The head was transverse above the pelvis but had not engaged. The lower uterine segment was very thin and reached to the umbilicus. When forceps failed, the patient was advised to go to the hospital, but refused. The back of the child was to the mother's right. An attempt was then made to deliver by version, and one leg of the child was brought into the vagina. At this point the uterus ruptured, and the child could be felt upon the left side of the abdomen, and the contracted uterus upon the right.

The patient was finally transferred to a hospital, and upon opening the abdomen a large quantity of blood and amniotic fluid was found. The child was readily delivered. The uterus was torn across the lower uterine segment, extending two-thirds around the cervix and into the body of the uterus. Both uterine arteries were bleeding; the bladder had been ruptured. The broad ligaments were clamped and the uterus amputated above the cervix, the rent of the bladder repaired with silk suture, and the peritoneum was stitched over the uterine stump. The abdominal cavity was flushed with hot saline solution and immediately closed. The patient made an uninterrupted recovery.

[This case recalls a recent experience of the reviewer: A physician had attempted twice with Tarnier's forceps to deliver a multipara, who had had difficult labors. The head of the child was movable above the pelvic brim. The forceps slipped. At the second application bleeding occurred, which led the operator to desist. When seen in consultation the patient was considerably shocked. She was transferred to the hospital, the abdomen opened, and a dead child extracted; the uterus was amputated, the fundus, tubes, and ovaries were removed, and the stump was fixed in the lower angle of the wound. On examination, a tear in the posterior wall of the vagina, sufficiently large to admit four fingers, was found communicating with the abdominal cavity. This wound was closed by suture from above, and the abdomen closed without drainage. The patient made a satisfactory recovery.]

Experimental Study in Hemorrhage, and its Bearing on the Treatment of Ruptured Pregnancy.—ROBB (*Amer. Jour. Obstet.*, October, 1908) contributes a paper giving the results of thirty-one experiments upon animals, in severing the uterine and ovarian arteries for the purpose of studying intra-abdominal hemorrhage. The results indicate that intra-abdominal hemorrhage, such as occurs in women suffering from collapse after the rupture of an ectopic gestation, is not sufficient in itself to cause a fatal termination. Death results from shock often increased by interference. While it may be urged that the lower animals can bear hemorrhage better than the human subject, the extensive severing of vessels more than counterbalanced the difference. By these experiments it was found that clotting probably occurs from within fifteen to twenty minutes after the vessels have been opened, and this time can be known by observing the hemoglobin index. Subcutaneous injection of salt solution probably does not cause renewed hemorrhage. Manipulation of the tissues, disturbing the clot, does result in continuing the hemorrhage. By bandaging the abdomen, or by applying a moderate weight over the lower abdomen, the pulse is made slower and of better quality, and the percentage of hemoglobin is kept up.

Modern Cesarean Section.—WARREN and POLAK (*Amer. Jour. Obstet.*, October, 1908) contribute papers upon this subject. Warren describes 5 cases of successful section and one case of a young primipara, weighing 200 pounds, who had a true conjugate of three and one-fourth inches. Spontaneous labor and forceps failed. The head was exceedingly hard, and the conditions such that other operations were rejected and the patient delivered by section. She died of sepsis on the third day. This case illustrates the danger of attempting delivery by other methods before

resorting to section. As usually happens, interference by forceps was practised by the attending physician before summoning consultation. Warren draws attention to the frequent occurrence of overgrowth of the fœtus and the resulting dystocia. He is in favor of the elective section.

Polak's record of 14 cases gives the recovery of the mother in 13, and 1 death. In some of the cases the patient was sterilized by the removal of the Fallopian tubes. In several, complications of varying degree arose, especially in those in whom labor had been going on some time before operation. Nine of the operations were performed for contraction of the pelvis; 3 were for dystocia resulting from ventrofixation of the uterus. Two patients were operated upon for tumors, which became lodged in the pelvis, preventing the descent of the child. The abdominal incision was made one inch to the right of the median line, taking the umbilicus as its central point. The uterus was incised within the abdominal cavity. In one case a tourniquet was used to control hemorrhage. The uterus was closed by chromicized catgut, the stitches including the peritoneum and muscle, but not passing through the endometrium. Three pregnancies have occurred in patients operated upon. The uterus has developed normally in these cases and spontaneous delivery occurred after induced labor. In 2 cases a gauze drain was used, and it was necessary to tampon the uterus to prevent hemorrhage. Chloroform and oxygen proved a very acceptable anesthetic. It was noticeable that the fœtus was not anesthetized. Ergotole was given, two injections of 30 minims, just before the anesthesia was started and after the delivery of the child. In the fatal case the patient had an intestinal fistula at the site of one of the abdominal sutures, caused by a needle puncture, and inclusion of the gut in the suture at the time of operation. A mixed infection followed which attacked the respiratory tract, the patient dying of pneumonia.

GYNECOLOGY.

UNDER THE CHARGE OF

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The Results of the Radical Vaginal Extirpation of the Uterus for Carcinoma of the Cervix.—C. STANDE (*Zent. f. Gynäkol.*, 1908, xxxii, 1201) makes a longitudinal incision through each lateral wall of the vagina, extending the incision deep into the parametrium. This enables him to remove a large portion of the pericervical tissue to which he attaches greater importance than to the removal of glands. He has operated in this way upon 104 patients, 21 of whom died as the immediate result of operation. The greatest danger in this method lies in infection through the vaginal incision, which was the cause of 9 deaths. Injuries to the bladder occurred six times and to the uterus six times. Recurrences of the carcinoma have appeared in 39 cases, the recurrence being located usually in the scar. In only three instances has the recurrence been in

the glands, one of which was in the inguinal glands. In 31 out of the 39 cases the recurrences were manifested during the first year, 5 during the second, 2 during the third, and 1 during the fourth. In 8 of the cases operated upon it was not possible to remove all of the growth, and 4 of these died as the immediate result of the operation, and 4 from recurrences. In addition to the 104 cases operated upon, Stande has had 52 cases of carcinoma of the cervix, 13 of which refused operation; the others were considered inoperable. Recurrences have not appeared on 17 out of 41 cases, or 41.5 per cent. under observation for five years or more since operation.

A New Method of Extirpating both Appendages.—O. BEUTTNER (*Zent. f. Gynäkol.*, 1908, xxxii, 1033) makes two transverse incisions in the fundus extending into the uterine cavity and including between them a wedge-shaped piece of the uterus with the insertion of both tubes and the attachment of one or both ovarian ligaments at the sides. This wedge-shaped piece is then divided in the median line and each appendage is liberated from the uterus outward, an ovary being left if possible. In this respect the method has the same advantages as that of Faure, in which the uterus is divided in the median line to the internal os and each half of the cervix amputated, the halves of the uterus and the appendages being then freed from within outward. In women still menstruating Beuttner, however, desires to retain the uterus and he finds, moreover, like Dührssen that this method of resecting the fundus has a very favorable effect in curing a chronic metritis.

A New Intraperitoneal Method of Shortening the Round Ligaments.—W. LATZKO (*Zent. f. Gynäkol.*, 1908, xxxii, 1278) describes a method of shortening the round ligaments which he has employed in over 100 cases during a period of eight years, with no accidents and only exceptionally a recurrence of the retroversion. The round ligaments at points as remote from the uterus as possible are sutured to the fundus in the median line, and beginning at this point the loops of the round ligaments thus formed are sutured together by through-and-through sutures and to the uterus in the median line anteriorly. The loops are thus brought together as far toward the cervix as possible, below which point the two newly made folds of the broad ligaments are also sutured to the anterior wall of the uterus in order to prevent the entrance of a loop of intestine into the pocket otherwise formed.

Perforating Wounds of the Uterus Inflicted during the Course of Intra-uterine Instrumentation.—HEINECK (*Surg., Gyn., and Obst.*, 1908, vii, 424) believes pseudoperforation of the uterus though of exceptional occurrence, is a clinical condition and that spontaneous perforations of that organ, due to preëxisting pathological conditions of it, can and do occur. Heineck insists that perforating wounds of the uterus, whether intraperitoneal or extraperitoneal have a morbidity and a mortality—conditions which increase in direct ratio with the inexperience, the carelessness, the surgical ignorance, and the surgical uncleanness of the operating surgeon. In the 154 tabulated cases 42 had a fatal ending. Of the 66 cases, in which expectant treatment was employed, 21 resulted fatally. Laparotomy, including apparently necessary intra-abdominal work, was

performed seventy-two times. In this class 17 deaths are recorded and 3 unstated results. Vaginal hysterectomy was done fifteen times, resulting four times in death, and in one no result is given. Heineck expressly states that dilatation of the cervical canal and instrumental curettage of the uterine cavity are, owing to their associate dangers, not office operations. In these operations general anesthesia is advised and the following rules suggested: (1) Ample cervical dilatation during which the cervix should be steadied should be a preliminary step to uterine curettage. (2) Intra-uterine instrumental maneuvers should be attempted only by those (a) who are thoroughly conversant with modern surgical asepsis and antisepsis; (b) who are capable of recognizing malpositions of the uterus and pathological conditions of that and of neighboring organs; and (c) who are acquainted with the treatment of the dangers incident to the successive steps of the intra-uterine operation they are performing. Heineck advises once the uterus is perforated, suspension of all further intra-uterine instrumentation except careful removal of the uterine contents by a finger or, while the uterus is being watched through a laparotomy incision, with a curette. In 2 cases swabbed with carbolic acid death followed. Intra-uterine irrigation following such perforations are opposed. Vaginal hysterectomy is opposed. The conditions in uterine perforations indicating laparotomy are the presence of infection, large-sized or multiple perforations, the presence of coexisting vascular, omental, or intestinal lesions, and prolapse of viscera through the opening.

Primary Implantation of an Ovum in the Pelvic Peritoneum.—HIRST and KNIPE (*Surg., Gyn., and Obst.*, 1908, vii, 456) state that in order to substantiate the claim that there has been a primary implantation of an ovum in the peritoneum, the presence of the following conditions is necessary: (1) A normal condition of the tubes, ovaries, and broad ligaments, except where the ovum is implanted; (2) no penetrations of the intraligamentary space from the ovarian fimbria; (3) no intra-ligamentary rupture of the tube; (4) no escape of the ovum from the uterine cavity; (5) proof that the peritoneum constitutes the reflexa of the ovum. Galabin and Witthauer have each reported an authentic case of primary implantation of the ovum in the peritoneum, and Hirst and Knipe report a third that meets the requirements just mentioned. In passing, mention may be made of the inaccuracy of the first condition, as pathological conditions of the tubes, ovaries, or broad ligaments may coexist and even antedate such implantation.

The case of Hirst and Knipe is as follows: The patient, aged thirty-one years, had one child seven months ago after a normal labor and has had no other pregnancy. Her menses began at the age of fourteen years and have always been regular and normal; her family history was negative. Three months after the birth of her child, which she is nursing, menstruation recurred twice a month. During all the six days just preceding her admission to the hospital she flowed. On the sixth day while stooping over she was seized with pain in the lower part of the abdomen, very severe in character and producing faintness. Pain and syncope recurred six times during the evening. Operation was one March 27, 1907. Free blood in moderate quantity was found in Douglas' pouch. On the posterior surface of the left broad ligament

was a spherical tumor, with a small orifice on its surface from which blood was exuding. The tubes, ovaries, uterus, and remainder of the broad ligaments were perfectly normal. The tumor was covered with peritoneum. A small embryo was found in it. A microscopic examination demonstrated the capsule to consist of an outer and an inner layer of fibrous connective tissue between which an extensive extravasation of blood had occurred. Around two-thirds of the periphery of the ovum may be distinguished nuclei of the endothelial cells of the peritoneum. At the point of erosion chorionic villi are seen protruding into the orifice.

Physical and Psychical Conditions Persisting after Mutilating Operations on the Female Generative Organs.—HOLCOMBE (*An. Gyn. and Ped.*, 1908, xxi, 361) believes physical and psychic conditions frequently persist for long periods of time after mutilating operations on the female pelvic organs, but that they are commonly in evidence before the operations. The opinion is offered, however, that not infrequently such conditions result from operation. In this latter class Holcombe believes that either the mental and general physical conditions are not well known, or the operation is not a proper one, although it is admitted that the gynecological surgeon may have such knowledge and yet believe the surgical treatment is imperative. Holcomb emphasizes the necessity for careful after-treatment of patients subjected to operations on the female genitals.

OPHTHALMOLOGY.

UNDER THE CHARGE OF

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The Operative Treatment of Optic Neuritis.—VICTOR HORSLEY (*Ophthalmoscope*, September, 1908, 658) sums up his position as follows: Optic neuritis should be treated as soon as detected; operative treatment should consist, in the absence of other indications, in opening the subdural space in the temporal or subtentorial region. The bore-hole and release of fluid ought to be unattended by any risk if the aseptic technique is adequate. Against the opinion that the neuritis is no help in the localization of the tumor, Horsley asserts that the lesion is upon the side upon which the neuritis is the more marked, or is the older. While nothing can be done for cases which exhibit well-marked atrophy, there are all sorts and degrees of atrophic changes which may be present and which ultimately disappear, with good results as regards vision, if the source of the neuritis be removed.

The Treatment of Congenital Cataract.—COLLINS (*Ophthalmoscope*, September, 1908, 675) advises to wait before needling, with which operation it is best to begin in nearly all cases, until the child is ten months old so that the eye may be sufficiently developed, the aqueous present in adequate amount, etc. Iridectomy should be performed if the pupil does not dilate well under the mydriatic. In Morgagnian cataract it is advisable to evacuate the chamber to obviate increased tension. If a dense membrane remains it should be displaced downward and backward.

Punctate Atrophy and Pigmentation of the Choroid.—GEFF (*Archiv f. Augenh.*, 1908, lix, 383) reports a very unusual instance of punctate atrophy of the choroid in a young man without specific history. The earliest appearances were noted in the extreme periphery and consisted of light-colored spots; these increased in size and were gradually surrounded by a pigment border, new foci at the same time extending toward the centre and gradually undergoing the same changes. There was a central scotoma for form and color, but the fields were not contracted.

Treatment of Fistula of the Lacrymal Sac by Electrolysis.—LOTIN (*West-nick. Ophth.*, 1907, 655) passes a current of 5 ma. during five minutes between the anode, which consists of a silver or platinum wire inserted into the fistula, and the cathode placed in the nares of the same side. The current is reversed at intervals. Rapidity and efficacy are claimed for the method to a remarkable degree even in invertebrate cases. In stenoses an isolated sound like the one recommended by Lagrange is employed, connected by preference with the cathode.

Dangers of Radium in Paste.—LE BON (*La clin. ophthal.*, 1908, No. 18, 293), to obtain the maximum of radiations from radium, has found that a paste applied directly to the desired region is the most effective. Accordingly, in therapeutics a paste has been applied immediately upon the skin, or cavities, in the treatment of nevus, angioma, epithelioma, eczema, etc. In a nevus of the forehead and eyelid of a restless infant so treated, DE COURMELLES observed that the paste after drying was exfoliated with the underlying tissue in scales; if the same event had occurred in an organ or cavity, extensive burns would have resulted. The reporter proposes to return to the use of tubes; although the latter are somewhat more troublesome, they are readily antiseptized and do not entail the above risks.

Extraction of Cataract in a Rhinoceros.—MATER (*Woch. f. Ther. u. Hyg. d. Aug.*, i, 42), with the aid of fourteen assistants, six journalists, three photographers, and ten attendants, extracted a cataract from the eye of a rhinoceros in the New York Zoological Garden. The operation lasted about half an hour and gave a successful result, which is by no means always the case in the lower animals. The operation was done under anesthesia for which purpose 900 grams of chloroform and 200 grams of ether were required, several of the attendants being nearly overcome during the process. A great difficulty was keeping watch upon the heart of the animal for the skin was so thick that the pulse could not be perceived.

Ophthalmia from Exposure to Snow.—GONIN (*Annal. d'oculist.*, September, 1908, 161) observes that references to disturbances of vision from exposure to the bright light reflected from snow occurs as early as in Xenophon's *Anabasis*, who states that he was compelled to abandon some of his soldiers on the route whose eyes had been "overwhelmed" by the snow. Modern writers have shown a disposition to question its occurrence. Such skepticism is doubtless due to the improper designation "snow-blindness" which the affection has popularly received. As a matter of fact the lesion most commonly observed is really a mild form of conjunctivitis, due in all probability to the ultraviolet rays, as is the case also in inflammation from exposure to electric lights. The retina is protected by the well-known property of the crystalline lens to absorb those rays and thus prevent their injurious effect upon the deeper structures. Hemeralopia, nyctalopia, and erythropsia have all been occasionally observed, but the mechanism of their production is obscure.

PATHOLOGY AND BACTERIOLOGY.

UNDER THE CHARGE OF

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The Interdependence of the Glands with Internal Secretions.—In a long and elaborated series of experiments, EPPINGER, FALTA, and REUDIGER (*Ztschr f. klin. Med.*, 1908, lvi), show that the physiological actions of the thyroid gland, the adrenals, and the pancreas are intimately connected. The extirpation of one of these glands acts upon the organism in two ways, directly through the loss of internal secretions, and indirectly by a disturbance in the function of the glands. The simple direct effect of extirpation of the thyroid gland upon the general metabolic process, showed itself, in starving dogs, particularly by a diminished excretion of nitrogen. The simple direct effect of an oversecretion of the adrenals, imitated by injections of adrenalin in starving dogs, was seen in an increased excretion of nitrogen and in the appearance of glycosuria. It was found now that extirpation of the thyroid had an indirect influence upon adrenalin glycosuria, for adrenalin glycosuria could not be produced in thyroidectomized dogs. By feeding these dogs thyroid extract, however, they could again be made susceptible to adrenalin glycosuria. No less remarkable was the effect of injections of adrenalin in dogs whose pancreas had been removed. Following injections of adrenalin in such dogs, the excretion of sugar and output of nitrogen was much increased above that observed in dogs

whose pancreas had been removed and in whom adrenalin had not been injected, and the dextrose-nitrogen co-efficient was almost doubled. The removal of the thyroid secretion from the body by extirpation of the gland had, on the other hand, an exactly opposite effect on dogs whose pancreas had been removed. Preliminary removal of the thyroid decreased the excretion of the nitrogen and sugar when the pancreas was removed. If the two glands were removed simultaneously the decrease in nitrogen and sugar output was not observed until a day or two after the operation.

The experiments show that, under normal circumstances, the thyroid exerts an inhibitory action upon the internal secretion of the pancreas. When the thyroid is removed, the inhibitory influence upon the function of the pancreas is done away with and there is a "hyperpancreatism," while excessive secretion of the thyroid gives rise to a partial insufficiency of the pancreas and to an increased action of the adrenal. The adrenals also possess a marked inhibitory action, even greater than the thyroid, upon the pancreas, and besides seem to increase the action of the thyroid. The secretion of the pancreas inhibits both the action of the adrenals and thyroid. Further experiments seemed to show that the sympathetic nervous system and vagus nerves were at least in part responsible for the conduction of these influences from one gland to the other. It could be shown that the glycosuria produced by puncture of the floor of the fourth ventricle, was analogous to adrenalin glycosuria, inasmuch as removal of the thyroid gland prevented the appearance of glycosuria following injury to this particular portion of the nervous system. The adrenal glands are known to bear a close relationship to the sympathetic nervous system, and it seems quite probable that increased action of the chromaffin system in general leads to an overexcitability of the sympathetic nerves, while loss of function results in decreased excitability. Not only the adrenals, but the thyroid as well, may act as a direct excitant to the sympathetic nerves, for adrenalin mydriasis could be obtained constantly in normal and even thyroidectomized dogs by the feeding of thyroid extract. The thyroid seems, however, to have a double action and influences the vagus nerve as well as the sympathetic nerves.

Between the pancreas and the nervous system it is much more difficult to establish a relationship, though it seems very likely that the pancreas is not only influenced by, but influences, the vagus nerves. To show that the internal secretion of the pancreas is under the direct control of the vagus nerve, a number of experiments were performed. It was found that when the vagus was paralyzed by the administration of pilocarpin, excessive internal secretion of the pancreas, or "hyperpancreatism," resulted, and injections of adrenalin failed to produce glycosuria. On the other hand, injections of atropine seemed to stimulate the vagus, and so depress the function of the pancreas that the effect of thyroidectomy was outbalanced, and the injection of adrenalin in thyroidectomized dogs to which atropine was administered, gave rise to glycosuria.

The application of the results of these experiments to the phenomena observed in certain diseases of the ductless glands is obvious. Among other conclusions the authors draw attention to the close relationship between changes in function of the chromaffin system and diabetes

mellitus. It is possible that diabetes may be brought about through some perversion of the function of the chromaffin system as well as by actual disease of the pancreas itself.

In connection with this work some recent experiments of PEMBERTON and SWEET (*Archiv. Int. Med.*, 1908, i, 628) are of great interest. They have studied in dogs the effect of injections of the extracts of various organs upon the flow of pancreatic juice after the administration of secretin. By means of a calibrated cannula, inserted in the pancreatic duct, they were enabled to measure with accuracy the rate of flow of the pancreatic juice. They have found that extracts of the adrenal glands and of the nervous portion of the pituitary body contain a substance which cuts short the flow of pancreatic juice excited by secretin, and prevents the stimulation of the pancreas by secretin when its injection precedes the secretin. Both extracts produce a rise of blood pressure, but the inhibitory action is not due to this factor, for in isolated experiments a rise of blood pressure was obtained without an inhibition of the flow of pancreatic juice. Section of the vagi had no influence upon the action of the adrenal and pituitary extracts. As far as could be learned, this inhibitory action upon the secretion of the pancreas was specific for the adrenal and pituitary bodies. Injections of extracts of the brain, of the liver, and of the testes, of atropine, and of digitalis had no effect upon the flow of pancreatic juice. It is interesting to note, in the light of the experiments of Eppinger, Falta, and Reudiger, that extracts of thyroid gland were equally ineffective.

The Connection Between the Proteolytic Ferments of the Leukocytes and General Immunity.—JOCHMANN (*Ztschr. f. Hyg. und Infectkrank.*, 1908, lxi, 71) has made some experiments to determine whether the proteolytic ferments contained in the polymorphonuclear leukocytes are in any way related to bactericidal substances or to the "microcytase bactericidal alexin" of Metchnikoff, which, according to him, is supposed to reside in the polymorphonuclear leukocytes. Jochmann could not find that the enzymes of the leukocytes had any destructive action upon living bacteria, nor were they capable of hemolyzing living red blood corpuscles. The enzymes do not act as a complement, nor do they destroy toxins. The enzymes do, however, digest dead bacteria in vitro, and Jochmann thinks that this property explains the disappearance of bacteria ingested by polymorphonuclear leukocytes.

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ORIGINAL ARTICLES.

GASTRIC NEUROSES.

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THERE is, perhaps, no single word in medical terminology that has been made to cover so many deficiencies in learning and diagnostic acumen as the term "neurosis." For years it has been accepted as a full explanation of innumerable morbid phenomena and processes beyond the range of contemporary medical knowledge; and to no class of disease has it been more freely applied than to certain forms of disease of the stomach.

The very complexity of the classification and description of gastric neuroses in the text-books, the diversity of opinion concerning their causation, and the innumerable modes of treatment suggested by various authors lead us at once to question the supposed facts concerning them. The use of many drugs for a single condition leads us to doubt the value of any one; and irreconcilable differences of opinion on theoretical questions in medicine and surgery lead us to doubt the statement of any of the disputants. There can be no doubt, however, that there are certain morbid gastric conditions which have been and are still classified as neuroses, and that the surgeon as well as the medical practitioner is often called upon to confirm a diagnosis or suggest a treatment. It will be my purpose, then, to consider these so-called gastric neuroses, especially in so far as they concern the surgeon. Those manifestations of gastric disturbance primarily psychic in nature or associated with grave organic nervous lesions evidently do not come within the scope of such a discussion. We may discuss them, granting their

existence, but realizing their non-importance as regards the question at issue.

What concerns us particularly is that set of gastric symptoms classed grossly as "nervous dyspepsia." Under this general term have been grouped the most diverse symptom-complexes, with, as a rule, but little understanding of the underlying principles of the case. It is true beyond a doubt that there are certain disturbances in the gastric function, motor, secretory, and sensory, for which we can, by the minutest examination, find no organic basis. Besides grouping them into these three classes, we may also classify them as conditions of irritation or depression. Thus, gastralgia, nausea, and gastric hyperesthesia are prominent types of sensory disturbances; hyperchlorhydria and hypersecretion are well-known types of secretory disturbances; while atony, pylorospasm, and pyloric insufficiency represent well-known varieties of motor disturbance. Needless to say, motor, sensory, and secretory aberrations may all be combined in a given case, and it is by various combinations that the different types of so-called "nervous dyspepsia" are produced.

When we speak of any one or more of these conditions as a neurosis, we exclude by that very term the presence of an organic stomach lesion to account for the symptoms, or the existence of a lesion beyond the stomach which gives rise to them reflexly. Accepting them as neuroses, what is their frequency of occurrence, how may they be correctly diagnosed and treated, and in what way do they reach the borderline of surgical practice?

As a fundamental principle we can safely state that a gastric neurosis without other neuroses or neurasthenic conditions is a most rare thing. In practically every case in which we finally conclude that the condition is a true neurosis it will be found that it is but one of a train of neuroses affecting the most diverse body functions and most widely separated organs. Careful examination may often be necessary to bring this fact to light. The gastric symptoms may so overshadow all others that attention is directed only to them. We would expect to find these neurotic or neurasthenic conditions most frequently in females, in the third and fourth decades of life. The picture that would present itself at once to the mind is that of a more or less emaciated, weak, and anemic patient. Often this may be realized, yet how often do we find neurasthenic manifestations, gastric and other, in the well nourished, and even robust, in persons of either sex, and in those in whom they might least be expected. Thus, for example, nervous gastric manifestations are not uncommon in farmers, a class in whom we would least expect to find them.

In what order of frequency do we find the symptoms? Of the sensory disturbances we find more or less anorexia or at least capriciousness of appetite in almost every case. It is such a constant

symptom in both organic and functional stomach diseases that in itself it is of but little value. Practically every sufferer from every form of gastric disease, real or imagined, complains of it at one time or another, and, as I have stated, the universality of the symptom renders its diagnostic value small. True gastralgia I have found very rare. It has been my experience that it is not a disease in itself, but a manifestation of disease of a definite organic nature, be it in the stomach, the central nervous system, or elsewhere. To this I will return later in speaking of its diagnosis.

Of the secretory disturbances, hyperchlorhydria is by far the most important. It is far more frequent than hypersecretion or gastrosuccorrhœa, which in its true form is indeed very rare, or than deficiency in hydrochloric acid in the gastric juice. Immediately there arises the question as to our ability correctly to diagnosticate such a condition of hyperchlorhydria, even if it be present. In spite of the vast amount of research work done upon the chemistry of the gastric contents and secretions, it cannot but be admitted that our knowledge concerning them is vague to a degree, and that our methods of examination are extremely crude. The normal variations of the amount of hydrochloric acid in the stomach contents and secretion at various ages and various stages of digestion, the individual deviations from a fixed standard, are very great. The normal amount for one person may be deficient or excessive for another. From a period of comparative confidence in our examinations of the chemistry of the stomach we have come to one of doubt and uncertainty. Where once an examination of the stomach contents was supposed to clinch the diagnosis in most instances, it is now generally considered of secondary value. My own experience with gastric analyses has been most unsatisfactory. Where once I had hoped that they would lead us to the possibility of definite diagnoses of ulcer, carcinoma, and secretory disturbances unaccompanied by organic lesions, I have now almost come to the conclusion that a gastric analysis is too often of but little help to a diagnosis. Yet extreme cases of hyperchlorhydria can be so diagnosticated, and do at times occur in the absence of anything that would seem to account for the condition.

As will be seen later, sensory and secretory disturbances of the gastric function are of import to the surgeon from a diagnostic point only. As we enter the field of motor disturbances we approach the scope of surgical treatment as well as diagnosis. Vomiting, eructations, and colic are, as a rule, but symptomatic. We may have apparently causeless, often repeated, attacks of vomiting, or vomiting of special articles of diet, in which operation or autopsy fails entirely to give us even a clue to the causation. In a recent article by a prominent surgeon published in the *Annals of Surgery*, a number of such cases are cited, and the author has apparently had brilliant results from exploratory operation, made, however,

upon false diagnoses. He even goes so far as to recommend operation for the cure of such a neurosis—an extremely radical and, to my mind, untenable position. A patient upon whom a gastro-enterostomy was performed not only had no relief of symptoms but was much injured thereby.

Atony of the stomach also cannot at times be considered as anything but a neurosis, and its treatment falls fully as much within the province of the surgeon as of the internist. In the diagnosis of this condition we are again confronted by the lack of exactness of our methods of examination and the difficulty of fixing a standard with wide enough limitations to include all normal cases and yet of sufficient definiteness to be a standard.

Finally, we have that vague group of symptoms, sensory, motor, and secretory combined, which, in the absence of any definite or tangible demarcation, has been called "nervous dyspepsia." It includes definite feelings of distress, pain or heaviness in the epigastric region, eructations, anorexia, gastric torpor rather than marked atony, intervals of excess of acid secretion, and an associated intestinal derangement, with almost invariable constipation. This is the chronic picture of "nervous dyspepsia." It may entirely simulate a chronic gastric catarrh. It may include few or many symptoms, it may be a grave menace to the health of the patient, or merely a source of continual annoyance. It is the bane of both patient and physician; a long, slow, ever-increasing load of discomfort to the sufferer. Probably this may be due to the neuroses at times; as I hope to show later, it usually is not. Granted, even, that it may be, the name "nervous dyspepsia" has been overworked almost more than any single phrase, not even excepting the "uric acid diathesis."

It will be seen, then, that a gastric neurosis is a thing of infinite variations. It changes its symptoms from week to week—one might almost say from day to day. It may show itself in a complex group of symptoms or in the persistence of one particular inexplicable annoying condition.

The diagnosis of a gastric neurosis is probably the most difficult of all to make. The methods of examination of the stomach which are definite may almost be confined to an estimation of its size by percussion and a determination of its capacity. I have already expressed my opinion, based on personal experience, of the methods in use for determining the gastric motility and secretory power; as a whole they are most unsatisfactory.

The most important features in the diagnosis of any gastric neurosis is the eliciting of a careful history, which will show us the general neurasthenic condition of the patient. His ocular or cardiac symptoms may give us a clue. The presence of a manifest general nervous breakdown with an undoubted neurasthenia would at once predispose us to consider, at least, any gastric symptoms

present as but local signs of a general process. Yet such local manifestations are often found in patients in whom we would least expect an asthenia of the nervous system as a whole. Then, again, this run-down condition may be a secondary neurasthenia, due to a primary lesion which underlies both it, indirectly, and the primary condition of the stomach most directly. Thus, a patient with a latent but not symptomless gastric ulcer would soon show gastric symptoms, which might be considered nervous in origin, as well as a general neurasthenic condition due to his sufferings.

The variability in gastric symptoms would again point to a neurosis. A patient with a definite organic lesion of the stomach has a cycle of more or less definite symptom-complexes, progressively going from bad to worse. The neurasthenic, on the other hand, shows with every fluctuation of his general condition a corresponding change in the gastric status. Yet how difficult the diagnosis may be can only be appreciated by those who have had many stomach cases under observation.

A gastric ulcer, for instance, may manifest itself in any number of ways. If, for instance, the pain is the most prominent symptom, and vomiting is absent, as it is in a number of instances, how apt one would be to attribute the pain to a functional condition, and to call it a true gastralgia. Treatment might relieve it somewhat, but the diagnosis would remain doubtful until some acute manifestation of the ulcer brought to light the true condition of affairs. Then, again, an ulcer of another type might have as its cardinal symptom the hyperchlorhydria so often found as an accompaniment of ulcer. The physician's attention would first be directed to the excess of acid, and the absence of great pain and perhaps of vomiting would make the false clinical picture of a severe secretory obstruction, with its concomitant train of evil symptoms. An ulcer, again, may show its presence primarily by the vomiting which it causes, yet be entirely without bleeding. How easy it would be to confound it with a purely functional vomiting. Again, it might remain entirely latent for long years and give rise only to that vague picture of "nervous dyspepsia" before mentioned. Almost as common as gastric ulcer, in the experience of some surgeons, is duodenal ulcer. Its symptoms even more frequently than those of the corresponding condition in the stomach fail of recognition. Many indeed of these cases are diagnosticated as "functional" or "nervous dyspepsia," and they are allowed to go on until perforation or profuse hemorrhage occurs, which, while it makes clear the diagnosis, shows us also that valuable time has been wasted and the patient allowed to lose his best chance of cure.

It is evident that text-books dealing with diseases of the abdominal organs must be rewritten, as the descriptions they now contain of the symptoms of diseases of these organs are of no moment at all in making an early diagnosis. Until these text-books are

rewritten on the lines of living pathology, they will remain useless as an aid in making an early diagnosis.

Carcinoma in its early stages also is much more often considered as a gastric catarrh or nervous dyspepsia than it is recognized. The physician of the past but too often has allowed these cases to go on to the stage of entire hopelessness before really making a correct diagnosis. Anorexia followed by the symptoms of a vague chronic gastritis or neurosis, when it occurs in a middle-aged person, is a condition which should excite our greatest apprehension, and be dismissed only after the most careful examination has been made—after the case, if obstinate, has come to operation. When the carcinoma early gives symptoms of obstruction, we have simulated the picture of chronic gastric atony, not because the stomach musculature is insufficient for its work, but because of a constantly increasing obstruction to the outflow of the stomach contents.

Not only do we know that such gross and evident conditions as typical ulcer and carcinoma of the stomach may give us symptoms of so various a nature as to correspond almost entirely with the old picture of nervous dyspepsia, but more recent clinical manifestations have directed our attention also to a less evident lesion of the stomach. I refer to that condition of puncture ulceration of the stomach mucosa with small early bleeding points, which may involve almost, if not quite all of the gastric mucosa. In the absence of the classical signs of ulcer, which we often have in this condition, the hyperchlorhydria present has often been mistaken for the main lesion. This is not to be wondered at, as it is only by surgical autopsies on the living that we have gained an accurate conception of the condition. Its etiology, again, is quite as obscure as that of many of the true neuroses.

Carcinoma and ulcer may not only lead to a simulation of the secretory and sensory manifestations of gastric neuroses, but also of the motor neuroses. The resemblances between the evidence of a beginning pyloric obstruction and a marked gastric atony I have already mentioned. Various varieties of vomiting occur in both these disorders, and also in those of less marked pathological changes, such as chronic follicular gastritis or minute ulcerations of the mucosa. The vomiting in these conditions, and in carcinoma at the outset of the disease, is often not to be distinguished from the purely nervous types of recurrent vomiting described by many authors.

It has always been my opinion that in very many of the cases of vomiting regarded as primary neuroses we have really a symptom only of some lesion in or outside of the stomach which, for some reason or other, we have been unable to determine. Vomiting as a pure motor neurosis is regarded nowadays as far less frequent than it was thirty years ago, yet that we occasionally see it does not

permit of contradiction. The following case was to my mind one of gastric neurosis, a case in which surgical treatment was ill-advised:

Mrs. —, aged twenty-nine years. Family history negative. Menstruation began at sixteen years, has always been regular; considerable pain. Has one child, eight years old. Never any miscarriages. Before having been operated on, six years ago, for perineal laceration (at which time there was also a curettement, shortening of round ligaments, and removal of small cysts from the ovaries), the patient had been subject to sick stomach and vomiting—in fact, difficulty in keeping anything on the stomach. Vomiting persisted, with nausea and great gastric distress, coming on soon after eating. Six months following the first operation a second operation was done (removal of both tubes and ovaries). Two years ago a gastro-enterostomy, and six months later an entero-enterostomy was done. The patient now came under my care, with a request that I operate on her. The symptoms complained of were much the same as originally: vomiting, the patient keeping nothing on the stomach, vomiting soon after eating.

Physical examination demonstrated nothing other than a movable right kidney. After having the patient under observation some days, making the usual tests which are done at the present time, I determined that she had a neurosis, and had had from the start; also, that I would operate on her with the idea of restoring the abdominal anatomy to its normal condition, minus the tissues, in the shape of intestine, necessary to remove. I opened the abdomen and excised the bowel included in the entero-enterostomy and gastro-enterostomy, uniting the jejunum to the terminal portion of the duodenum, and closing the opening in the stomach where the gastro-enterostomy had been done. The patient made an uneventful recovery.

The effect of this operation was to my mind purely psychical, and the present condition of the patient is due to the mental impression made by it. I found no obstruction at either the gastro-enterostomy or entero-enterostomy openings.

Our careful studies of case histories and minute observation of living pathology have convinced us that causes previously overlooked or considered insufficient fully suffice to account for extremely grave symptoms. The impossibility of diagnosing a nervous dyspepsia with some slight catarrhal gastritis is manifest. It can be safely asserted that, while all sufferers from neurasthenia do not have gastric symptoms, all sufferers from chronic dyspeptic symptoms, from whatever cause, soon become neurasthenics.

Hitherto I have only spoken of the resemblance between so-called gastric neuroses and the symptomatology of organic gastric lesions. It will be evident that we must often be deceived in diagnosing the presence of a neurosis, that in many instances there is in a supposed neurosis but the beginning of a serious organic

disease. Yet not only in the stomach do we find conditions often unrecognized, to the symptoms of which the older clinicians often applied the term neurosis, but there are a host of lesions of other abdominal viscera which deceive us in the same way.

We are coming to recognize more clearly every year the fact that the various organs concerned in digestion form a system correlated in every part. The stomach, intestines, biliary system, and even the appendix, the latter often described as functionless, do their work regularly, in orderly sequence, to accomplish the preparation of food for assimilation. Earlier brilliant researches in the functions of any one viscus often placed before us the picture of digestion as a series of related but almost independent processes. As a result of this conception the influence of one part of the system on all the others was but too often lost sight of.

The biliary system will illustrate my meaning to perfection. A patient who suffers from gallstones with stomach pains of an atypical variety will furnish the exact picture of so-called "idiopathic" gastralgia. All the other symptoms of gallstone disease may be absent, and the pain is attributed to the stomach neurosis when it really has a basis in the very solid fact of biliary calculi. During the attack of pain a transient hyperchlorhydria is not uncommon, and our very effort at diagnostic refinement by means of the stomach tube may lead us into still greater error.

Pericholecystic and peripyloric adhesions are very commonly found in association with bile-duct lesions of long standing. When they encroach upon the stomach or duodenum they often cause symptoms entirely gastric. An indistinct or vague history, pointing to the primary lesion is often passed over in a cursory history and we are at once led to believe that we must look for the seat of disease in the stomach. Indeed, actual pyloric obstruction due to pericholecystic adhesions is not unknown. In these instances the slow and long-continued course of the illness puts a diagnosis of carcinoma out of the question, the "atony" of the stomach is much in evidence, and we may almost be pardoned for an error in the recognition of the true lesion.

Simple gallstone disease is often described in text-books as being without symptoms. We read of postmortem statistics in which these cases predominate, and it has been asserted that nine-tenths of all gallstone cases have no symptoms. This is certainly not true. Almost every case of such a "symptomless" group would, if the history were minutely scrutinized, give us the story of a patient afflicted for months, years, even decades, by "chronic dyspepsia." We have learned that while the great classical symptoms of gallstones are often absent, almost every case will show marked evidences of impaired digestion. These patients complain of belching, anorexia, vague epigastric distress and flatulence, etc. They are the very cases that so many practitioners put on such liberal diet of

pepsin, sodium bicarbonate, diastase, and remedies of a like nature, that it should excite our wonder that after a few months they are able to digest anything. Mr. Moynihan, of Leeds, in his lecture on "Inaugural Symptoms," has called attention very strongly to the fact that gallstones are not, as is often stated, without symptoms. He has aptly cited the term "gall-bladder dyspepsia" as accurately describing the digestive symptoms which precede by months or years the late or so-called "classical" signs of gallstones. Our medical and surgical authorities have commonly neglected to recognize or describe these phenomena.

Turning to another portion of the digestive tract, let us consider the appendix. Chronic disease of this little organ, so long erroneously termed rudimentary and functionless, gives us many cases of chronic dyspepsia. In part reflexly (pylorospasm), and in part by direct influence with the cecal and appendical functions by kinks, adhesions, and malpositions of the organ, the picture of a chronic intestinal indigestion develops, and is very hard to distinguish from dyspepsia having its primary seat in the stomach. We must not fail to recognize the fact that malpositions or inflammations of the appendix, as found in chronic appendicitis, may cause symptoms far removed from the organ by direct action upon the sympathetic nerve fibers which ramify in every part of the abdominal cavity. Only within the last few days I have performed two appendectomies for marked chronic appendicitis in patients in whom the entire pain and distress were located in the epigastrium, not even referred to the right iliac fossa (typical instances of pylorospasm). I have had similar cases many times. Each recurrent attack of pain is referred to as "colic," and the true origin of the seizure is but too often overlooked. The marked constipation and flatus which in so many instances is the accompaniment, cause, or result of a chronic appendicitis serve to render the patient's condition still more miserable. Medical treatment, or, indeed, any form of treatment, not directed to the removal of the cause of the patient's distress must of necessity be futile. It is true that we must be on our guard when diagnosticating such a dyspepsia as of appendical origin. The reverse of this dictum is also true—that in some instances an indigestion not arising in the appendix, but accompanied by constipation, with cecal distention and tenderness, may so simulate a chronic appendicitis that an appendectomy is performed. Any surgeon who has done much work in appendicitis can look back on not a few cases in which an appendectomy for a supposed chronic appendicitis, in the absence of a history of well-marked acute attacks, has failed to give the relief expected of it. Our internists and gastro-enterologists diagnose many cases of gastric, intestinal, and nervous dyspepsia. Hereafter they may save their patients much suffering and themselves much chagrin by more frequent diagnoses of gall-bladder dyspepsia, duodenal dyspepsia,

and appendiceal dyspepsia, and by advising prompt surgical interference. I have no doubt that such refinement of diagnosis is but the question of a short time.

I need but mention the gastric neuroses of various forms reflexly caused by renal lesions, such as movable kidney, lesions of the female pelvic organs, or of the male genito-urinary system, to call to mind a picture of disease difficult at times to diagnose, and extremely resistant to any form of treatment, but only indirectly within the province of the surgeon.

It is evident, then, that there are many conditions which directly or reflexly cause the occurrence of what is termed "nervous dyspepsia," and it is my firm belief that, as a rule, the origin of the symptoms can be found in some very definite lesion within or beyond the stomach.

Yet it must be admitted that there are certain cases for which, apparently, the term "nervous dyspepsia" must suffice as a diagnosis. When we have eliminated the possibility or probability of a fundamental lesion, and find a case in which there are the symptoms of dyspepsia, especially one in which the distress occurs only after the ingestion of food, but regardless of its quantity or quality, we may be sure that we have to deal with a true case of gastritis nervosa. The existence of the general symptoms of neurasthenia would make the assurance doubly sure.

What, then, is the attitude of the surgeon toward these cases? I think that it should be "hands off," with but very few exceptions. The surgeon's principal duty, as regards the true neuroses of the stomach, is to recognize them, to separate them from secondary dyspeptic conditions due to lesions which perhaps it is within his province to treat. I regard the proposition to operate on these cases for the mental effect upon their general neurasthenic or hysterical condition as unsafe, illogical, and as setting a most dangerous precedent. It is certainly a confession of weakness in our therapeutics, medicinal and psychic, to suggest such a course.

These cases belong to the internist and neurologist; whether the neurasthenia be primary or secondary to the stomach lesion, our treatment is the same. They are in need of rest, with general and special dietetic treatment. Removal of the primary mental cause is essential, and these patients demand the most careful management if their recovery is to be assured.

There is no exception perhaps to the general statement that gastric neuroses per se are not within the province of the surgeon. If we consider gastric atony and ptosis as really neuroses, when they are apparently primary, they form the exception. There are certain of these cases in which all medical and general treatment is unavailing, while a gastro-enterostomy promptly leads to recovery by furnishing the stomach with drainage, which by its own force it is unable to secure. In ptosis, I have never seen good results from the

various methods devised for the purpose of raising the stomach itself. I believe that gastro-enterostomy is the only logical procedure. This is true even in some instances in which the pylorus is entirely patulous. While I believe that an occlusion of the pylorus is the main indication for gastro-enterostomy, I do not think it is the only one.

In conclusion, I cannot do better than to repeat my warning against operative interference in neuroses of the stomach.

THE TREATMENT OF CHRONIC BRONCHITIS.

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CHRONIC bronchitis is due to so many causes that its successful treatment is a difficult problem and frequently baffles the most skilful therapist. If we are satisfied with treatment of symptoms, as is commonly done and as, of necessity, must frequently be done, a routine therapeutic procedure can easily be prescribed. But this cannot be satisfactory and, as a matter of fact, is not satisfactory. The patients most commonly give up consulting physicians and take such remedies as they choose, namely, some expectorant or opium, and the physician, after having prescribed all the routine remedies, finally tires of efforts which seem futile. It seems supererogatory to state that both causal and symptomatic treatment are necessary for successful treatment of any disease; it may be that the latter includes the former, but both should be applied when possible.

Causal treatment has not received sufficient consideration in chronic bronchitis, which can be explained by the fact that the etiology of chronic bronchitis is very complex and not always discoverable. As indicated by pathological anatomy, there are many forms as well as many stages in this disease; but in all forms there is some change which eventually produces loss of resistance and of elasticity in the elastic and muscular tissue of the bronchi. This may be due to a variety of causes acting upon the mucous membrane from without or from within the body, or upon some inherent weakness of the tissues themselves. For causal treatment the following may be taken into consideration.

1. *Local Causes.* Lesions in the nasopharynx; inhalation of irritating substances, mechanical, chemical, thermic; infections with *Bacillus catarrhalis*, the pus producers, *Bacillus influenzae*, measles, pertussis, tuberculosis, syphilis; diseases of the pleura—pleural adhesions, chronic exudates; diseases of the lungs—asthma emphysema, chronic indurations, tumors, chronic enlargement of the bronchial glands; and malformations of the thorax.

2. *Remote Causes.* Diseases of the heart; diseases of the kidneys; arteriosclerosis; rickets; scrofula, tuberculosis; chronic intoxications (alcohol, gout, auto-intoxications); obesity; heredity; all influences preventing normal respiration; refrigeration (catching cold); and all general causes predisposing to infections.

No case of chronic bronchitis should be treated without considering its cause or causes; but it will be seen from this list that some of these causes act upon the bronchial mucous membrane from within, others from without, some in both ways. In chronic alcoholism the alcohol which is eliminated by the lungs is the chemical irritant which produces the bronchitis. In all those infectious diseases in which the microorganism is carried by the blood current and then localizes itself the production of chronic bronchitis is from within. On the other hand, inhalation of irritating substances is an example of the production of chronic bronchitis from without. In tuberculosis we may have a combination of both modes of infection, as the bacilli may be inhaled, may be developed in the bronchi by extension, by continuity or contiguity, or may be carried by the blood or lymph currents. But whichever way the bronchitis is produced, it is necessary to consider the existence of some form of predisposition. This can easily be demonstrated by observation; the same local cause produces an ordinary acute bronchitis in one subject, in another it is followed by a subacute bronchitis which is the precursor of a chronic bronchitis; or, an acute bronchitis disappears and leaves a local predisposition to infection, or becomes a *locus minoris resistentiæ* to irritations of any sort, so that eventually a chronic bronchitis develops. Clinically most cases of chronic bronchitis not due to circulatory trouble develop from acute or subacute attacks of bronchitis which recur. The latter are looked upon as "only a cold," and therefore are not considered of sufficient importance to require attention. It is at this stage of the disease that treatment is most important; it may be possible to remove the damage done to the bronchial tubes, or further injury to them may be prevented. In the latter sense we are acting prophylactically, which in this disease is of incalculable value.

Catching cold, which consists of infection plus predisposition, should be prevented. The local predispositions in the nasopharynx should be removed; anything which produces mouth breathing puts in abeyance the filtering functions of the nose, and in its turn makes excessive demands upon the protective functions of the lower sections of the respiratory tract. When there is no mouth breathing, but simply local loss of resistance in the mucous membrane of the nasopharynx, gargling with large quantities of water and cleansing the nose by douching with indifferent solutions twice a day is of the greatest value. For our purpose, it is indifferent how the microbes which produce the "cold" reach the bronchial mucous membrane, whether by continuity of tissue or by the blood route, provided they are

removed from the first place of infection. This is effectually done in the way just described, as I have repeatedly seen when it was followed conscientiously. In "catching cold" the general predisposition should also be considered. It is common practice to advise peculiar kind of clothing, dry feet, care in exposure to draughts of air or to changes in temperature. It is very difficult to follow these directions unless the patient considers the prevention of catching cold the principal object of life, and many so consider it. Moreover, if general resistance can be increased the procedure is more natural, more easily followed, and more effective. This is done by the prevention of faulty metabolism and the deterioration of general health. These being attended to, the most important prevention consists in that procedure which has been called *Abhärtung* by the Germans—hardening. Essentially, this process consists in reducing the reaction of the skin to thermal irritations by gradual education. In doing this we reduce vasomotor reaction in the skin, which is followed by contraction of bloodvessels, and, therefore, we prevent sudden hyperemia in internal organs. Hyperemia upon mucous membranes is one of the principal predisposing causes of infection; this is shown for bronchitis in chronic heart and kidney troubles; acute hyperemia being prevented, the local predisposition is removed. That this is the only way in which the various procedures applied for hardening act may be denied; that the procedure is valuable cannot be doubted. Hardening is accomplished by hydropathic measures, the cold sponge, douche, or plunge; it should be done daily, and it should be modified in accordance with individual indications and limitations.

The infectious nature of "catching cold" should not be forgotten. While we rely upon normal or increased resistance to destroy bacteria, neither of these is present in patients with chronic bronchitis, and it is safer that they be kept away from infection than be exposed to it. It is justly and properly recommended that these patients be kept in the house during rough weather, or that they seek milder climates. Rarely, however, is it advised to prevent infection by not coming into close contact with other people who have a cold. Most people are not able to stay in the house or to leave home for a great length of time, and, after all, when they do the one or the other they are largely preventing infection. When a house epidemic of colds starts, the patient with bronchitic tendencies, who has been left in the house, gets an attack of bronchitis; when an epidemic of colds starts anywhere, in Egypt, Algeria, or Southern California, provided these patients are exposed, the exposure is followed by an attack. All this is thoroughly understood for influenza, and this has done not a little to our understanding of common colds; certainly it is not asking too much to keep predisposed patients away from the possibility of infection.

Auto-infection is more common than is supposed. The bacteria

which are found in the nasopharynx are more or less readily disposed of, as has been shown. It is a much more difficult matter when they are retained in the bronchial tubes, producing exacerbations by temporary increase of virulence or diminution of local or general resistance, or simply cause constant irritation by their presence. The removal of these bacteria when they are in the nose or throat may be easy, as has been described; when they are in the bronchi it is difficult but not impossible.

Bacteria can be removed from the bronchial mucous membrane mechanically, or they may be destroyed. Everything which increases secretion from the mucous membrane removes the surface bacteria; therefore inhalations, medicines, and other measures may be tried. For the destruction of bacteria in bronchitis little has been done. Remedies may be applied directly by intratracheal injections, or indirectly, as such that are eliminated by the bronchial mucous membrane when administered by the mouth or otherwise. Either way is useful, but there is no certainty that bacteria are destroyed; that their number may be diminished is not denied, but from what we have seen this is not sufficient. So that other things, in the way of protective measures, must be found to destroy bacteria, or, at least, to prevent their multiplication. Destruction of bacteria can take place by general means by the introduction of peculiar substances whose properties are well understood (bacteriolytins, bacteriocidins, etc.), but I do not know that they have ever been applied in the treatment in bronchitis. In a number of cases of streptococcic bronchitis, antistreptococcic serum has been valuable. It is much more to the purpose, at least at present, to destroy bacteria in this stage of the disease by improving local resistance, diminishing local predisposition, or increasing general resistance. A hyperemic mucous membrane has diminished local resistance and increased local predisposition; if the cause or causes are removed this disappears, bacteria cannot grow because their soil is rendered unfavorable and they are actively opposed in their growth. We are accordingly not astonished to find that digitalis has been successfully administered in chronic bronchitis. The thought has not come that it acts by relieving a cardiac cause. "Chronic bronchitis with profuse secretion," says the fifth edition of the U. S. Dispensatory (1904) "is the only inflammatory affection in which it (digitalis) may be advantageously used." As will be observed, it may be advantageously used because the disease is inflammatory, not because chronic myocardial insufficiency is relieved. General causes are of even greater importance in changing the local conditions; chronic intestinal auto-intoxication, gout, and alcoholism should always be considered and excluded. In a certain number of cases there is hereditary local predisposition due to some defect of physical or biological qualities in the respiratory apparatus; it is possible to detect this in children and to reckon with it.

The effect of diseased lymphatics upon chronic bronchitis has attracted little attention. There are very few cases of chronic bronchitis in which some change is not found in the bronchial glands, usually a hyperplastic condition clinically marked by enlargement of the posterior cervical glands. The existence of enlarged bronchial glands is easily explained by the direct transportation of the causal irritants to them and its localization within them. The enlargement of the cervical glands because of changes in the bronchial glands not only depends upon the inability of the lymph to be discharged in its proper manner, but the cause of the bronchial enlargement may also be the cause of enlargement of the cervical glands. Hart has shown that in injecting India ink into an animal there is a retrograde transport of this substance from the thoracic duct during inspiration, affecting many glands, but also the bronchial and cervical glands. Whether the bronchial glands be hypertrophied or, as they become later in the disease, atrophic, the effect upon the cervical glands is the same in regard to enlargement except as to degree. Under all circumstances enlargement of bronchial glands produces a distinct effect upon the condition of the lungs and bronchial tubes, which is greater in the mucous membrane of the bronchi than in the lungs, because they are more remote and because the forces causing lymph flow in them are of a more passive nature than in the lungs, especially when they are diseased. The effect produced is that of stasis in the lymphatics, causing a moistening of the whole mucous membrane, a dilatation of lymph spaces and compression of blood-vessels, a copious transudation into the lumen of the tubes, and a condition most favorable to infection. Moreover, functional activity of the protective agencies of the bronchi is diminished, which is followed by the usual results. The treatment of these enlarged glands is frequently followed by excellent results. As a causal indication it should always be considered.

As in all diseases produced by microbes, reduced general resistance is followed by reduced local resistance. It will be seen, then, that reduction of general nutrition, reduction of nerve tone, and anemia act as predisposing factors whose removal by proper treatment is invaluable not only in the first stage of the disease, but also when it has become thoroughly established.

Climatic treatment acts in various ways. There can be no doubt that external temperature is of importance; a patient whose exacerbations come with cold weather may escape them provided he goes to a warm climate. But is it overlooking the mark if this is the only factor taken into consideration in advising change of climate. Send this same patient to a warm or hot climate in a place in which he is constantly forced to breathe dust-laden air, and the result will be far from favorable. Again, the latter or the former may be absent, and yet a change in climate will do no good. Change of climate acts causatively as well as symptomatically; which should always be

considered when it is recommended. The way in which change of climate acts beneficially is not so easily explained as would seem on first thought; besides those already mentioned, moisture and altitude must also be considered, and it follows that recommendation of a proper place for an individual is very difficult. Moreover, in recommending change of climate we are not only guided by the disease, but also by the adaptability of the patient to such a change or to any change.

In a certain number of cases the chronicity of the disease is evident from the beginning, but in the greater number it begins as a "winter cough," which gets worse from year to year and lasts longer and longer. In these cases of recurring bronchitis prophylactic treatment is of the greatest value and usually neglected. The attacks should be treated as carefully as possible, the patient should be kept in the house, in bed when there is fever, proper medication prescribed, and his general health considered. In many individuals these attacks are followed by reduction in weight and strength, so that convalescence is slow and predisposition to infection increases. It is in such patients that superalimentation is necessary; many of them do well on codliver oil. Sometimes these attacks are provoked by dust inhalation, especially in cities, and I have known several patients ward them off by wearing respiratory masks. As a rule, this is impracticable, but those in whom this etiology is established, whose occupation causes inhalation of irritating substances, and in those who cannot leave home it should be encouraged. The best preventive is permanent change of climate; next comes temporary change during the season when the bronchial attacks occur. When the irritant can be removed, as is the case in smokers who inhale the smoke, much can be expected for prevention of recurrence.

For one reason or another our patient has gone into the next stage of the disease, in which he is never entirely free of his bronchitis and in addition has exacerbations. He now has pathological changes in the bronchi which are permanent and progressive unless something can be done for him. It matters not what form of chronic bronchitis is considered, the hypertrophic or the atrophic, the inevitable final result is destruction of muscular and elastic tissue. In the hypertrophic form there is great cellular infiltration, which at first prevents normal muscular and elastic functional activity and finally destroys it. In the atrophic form there is substitution of fibrous tissue for the normal in mucosa and submucosa. In all the forms there is change in the mucous membrane: in its epithelial layer from incomplete to complete loss of cells to metaplasia, and in the lower layer infiltrative or atrophic changes. There is much congestion of the bloodvessels. Sooner or later all the tissues are changed, including cartilage, by infiltration and final atrophy. All these changes are followed by change of functional activity. In the epithelium the protective power of the ciliated cells is lost, small foreign bodies as well as

particles of mucous cannot be removed. In the elastic and muscular tissues the function of motion is interfered with or destroyed, and the material which collects upon the mucous membrane is not removed and remains as a constant irritant to produce renewed irritation and inflammation. The changes in the deeper layers cause weakening and loss of resistance to pressure which are followed by dilatation of the bronchial tubes. Not only do the bronchial tubes dilate because of expiratory efforts, such as coughing, but ordinary inspiration may at times be followed by dilatation. Because of the effect of diminished respiration, which occurs in chronic bronchitis, as well as destruction of bloodvessels, changes in the heart, especially hypertrophy of the right ventricle, occur.

As failure of removal of secretion is then so important, it is no wonder that this removal has been looked upon as the principal object of therapy. It is true that the usual ratiocination is not the one I have just applied, but is as follows: Secretion into the bronchial tubes produces coughing, the more secretion the more cough, the more cough the more annoyance, therefore, the secretion should be removed or the cough be checked. Those medicaments called expectorants have been employed for this purpose. They are directed to increasing fluidification of the expectoration, to irritation, so that increased efforts are made to propulsion, and to causing the secretion to be dried up. In chronic bronchitis it is rarely necessary to employ the second kind of expectorant, to which belong musk, ether, camphor, ammonium carbonate, alcohol, and others; certainly routine use of any of these drugs is contra-indicated.

In the first class there are nearly all the alkalies—ipecac, apomorphine, ammonium chloride, and pilocarpine. In the third group there are turpentine, benzoic acid, and creosote, their preparations and derivatives, copaiba, myrtol, eucalyptol, tar, and the astringents, such as lead or tannic acid, and belladonna and its preparations. The iodides are also valuable as expectorants, since they liquify the expectoration; but as they are eliminated by the bronchial mucous membrane and irritate it, they should be cautiously administered in chronic bronchitis. Beyond the general indications it is impossible to decide between the various members of each group, except by considering the possibility of unfavorable activity. In the bronchitis of Bright's disease we should be very careful to give only such remedies as do not irritate the kidneys. Aside from these considerations, our preferences are determined by actual experience: of the first group I use chloride of ammonium, ipecac, the alkalies, and pilocarpine; of the second class of expectorants, camphor and carbonate or anisate of ammonium; and of the other group I prefer turpentine, the benzoates, creosote and its preparations or derivatives, eucalyptol, and tar.

The same effects follow inhalation as are produced by medicines. There is some doubt of their *modus operandi*, but there is no doubt

of their efficacy. In order that they attain their maximum efficiency the fluid used should be as finely subdivided, vaporized, as possible, and its temperature not too far from the internal temperature of the body. The apparatus are of variable construction—inhaling masks, so called atomizers or nebulizers, inhalation cabinets or chambers. The choice depends more upon the kind of patient than upon the nature of the case. I have obtained excellent results by using two layers of a frequently washed old woollen petticoat as an inhaling apparatus, but manifestly that would not do if the petticoats are neither old nor of wool. By using the old fashioned croup kettle an inhalation chamber may be improvised. For the purpose of fluidifying the expectoration, inhalation of aqueous vapor of sodium bicarbonate or of Ems water; for diminishing the expectoration, turpentine, tar, creosote, eucalyptus, menthol, and tannic acid, can be recommended, applied in the same manner.

Intratracheal injections seem to be followed by good results. The fluid is injected into the trachea by means of a peculiarly constructed syringe; but to do this requires training. The following substances, dissolved in olive oil, have been applied in this manner: menthol, carbolic acid, guaiacol, iodoform, morphine. From what I have seen, this mode of treatment has been beneficial, but only for relief of symptoms, and this can be effected by simpler means in uncomplicated cases of chronic bronchitis, so that, at least in this form, it is not necessary except in advanced cases.

In ordinary cases postural treatment is the best for the removal of secretion from the bronchial tubes. In a normal bronchial tube the secretion is removed during the night by the ciliated cells; when secretion is increased this is no longer possible, and the patient must remove it by coughing—always in the morning, frequently at night as well. The secretion collects and calls the protective function of coughing into action. Because of our position in bed during sleep the bronchial secretion either remains stationary, when the body is level, or, when the head is higher than the trunk, gravity forces it away from the larynx; in either case collection of secretion takes place. If we change these positions so that the head is lower than the trunk, bronchial secretion neither stagnates nor does it move in the wrong direction, as the combined effect of ciliatic motion and gravity is sufficient to remove comparatively large quantities of secretion. This is accomplished when the patient sleeps with the foot of the bed elevated; in most cases this is sufficient; at times, depending upon the side and seat of the lesion, combinations of ventral or lateral posture may be necessary. The foot of the bed may be elevated by putting wooden blocks or bricks under it; whenever it is possible it is advisable to get beds which are so constructed that one end can be elevated. Long experience has taught me that the first elevation should not exceed two inches; later this may be increased to four or five inches. The combined postures are

obtained by the use of pillows or bolsters in the inclined bed; as a rule, they are not successfully carried out, but in a number of instances I have obtained good results. Whatever is done must be done gradually. Frequently the patient is unwilling to try a posture which is the opposite of the one he naturally takes to relieve his symptoms (cough, dyspnea). Moreover, it is very difficult for most people to sleep with the head lower than the trunk. When therefore a patient is found who sits up all night so that he can cough more effectually, it will not do to begin immediately with elevating the foot end of the bed. This is true also in dyspnoea and in very nervous people. When these conditions exist, I ask that the patient try with fewer pillows, then the horizontal posture, and finally the elevated one. When this is done there are few failures in the continuance of the treatment. After the patient has tried to carry out directions for a few nights, there is no further difficulty. As soon as the patients can pass the greater part of the night with feet elevated the symptoms begin to disappear. They cough less during the night, therefore sleep better; the morning cough is diminished and the amount of expectoration is lessened or disappears entirely. In a number of instances I have seen what may be called a cure, as all symptoms of the disease disappeared, but relapses occurred after a longer or shorter time, as could have been expected from our etiological conception of chronic bronchitis. This mode of treatment is applicable to all forms of chronic bronchitis in which the removal of expectoration is essential. It therefore is of no value in dry bronchitis. It cannot be expected to be followed by benefit in cases in which gravity does not assist; for instance, when elevation of the feet prevents the emptying of a dilated bronchus, then a combined posture may be of service.

In foetid bronchitis intratracheal injections of iodoform in oil (0.4 per cent.), or inhalations of carbolic acid, equal parts of carbolic acid, alcohol, and glycerin, of thymol, 0.05 to 0.1 per cent. solution, of a 0.5 to 2.5 per cent. solution of oil of eucalyptus in alcohol and water, are useful. Internally A. Fraenkel recommends capsules each containing myrtol, 0.15 to 0.3 gram ($2\frac{1}{2}$ to 5 grains); not more than 1 gram (15 grains) to be given in the course of twenty-four hours. Tar preparations, turpentine, lead acetate, and many other remedies are also recommended to be applied in the same manner.

* The treatment of the cough in chronic bronchitis is an especially difficult problem; if we check the cough too much, there may be retention of secretion with all its consequences; if we permit the patient to cough too much, there may follow weakening of the bronchial coats and dilatation of the bronchial tubes. Too much coughing produces more cough, and too little coughing is followed by the same result. In addition, those remedies which reduce the cough reflex with certainty are accompanied by effects not altogether beneficial to the patient. As has been shown, diminution of expect-

toration is followed by diminution of cough. But in the dry form of chronic bronchitis there is little expectoration, and yet there is cough. When the cough is so annoying as to cause local or general symptoms, something must be done. The milder measures should first be tried: drinking of warm liquids, equal parts of Ems water and hot milk, frequently acts very well; the Species Pectorales of the National Formulary or some warm alkaline solution may be tried. In practice most patients have some especial form of tea which acts beneficially, but this fails with others, who, in their turn, are beneficially affected by a tea called by some other name but having the same ingredients.

This observation naturally led to the conclusion that excessive coughing results from some nervous mechanism which can be controlled by increased inhibition—let it be called autosuggestion. When the patient can be taught to inhibit the reflex which produces the cough, we possess an invaluable way of checking the cough and one which succeeds frequently. Most patients of average intelligence and fortitude can be taught to resist constant coughing; in some the autosuggestion must be reënforced by the administration of some drug which can be taken frequently without doing harm, in the form of a tablet, a lozenge, or a cough drop, containing horehound, althea, licorice, flaxseed, Iceland moss. In some instances hydrotherapy is valuable, the Preissnitz application around the throat or enveloping the whole chest. But there will be failures with any or all of the measures recommended, and then recourse must be had to remedies which reduce the cough reflex; the bromides and chloral are sometimes valuable, but commonly we must resort to codeine, heroin, or morphine. In a chronic disease the prevention of a drug habit is of the utmost importance; although a codeine habit does occasionally occur, it is very rare and easily relieved; therefore this drug should be administered first. If it does not give relief, heroin should be tried in small doses (0.004 to 0.008 gram; $\frac{1}{16}$ to $\frac{1}{8}$ grain); as Harnack first pointed out, it is more toxic than morphine, and heroinism (morphinism) does occur. Last of all, opium or morphine should be administered, preferably opium. There are very few cough mixtures which do not contain the one or the other.

The treatment by mineral waters is supposed to affect the expectoration, and this is probably the case when they contain alkalies or sulphur. But this indication is not the only one to be followed in sending patients to springs; frequently it is the removal of the cause which helps, or a combination of activities such as we always see following courses of treatment at springs. It is therefore difficult to be precise in indicating where the individual should be sent. Alkaline-saline and saline waters might be expected to loosen expectoration, therefore patients may be sent to Ems, Soden, Kissingen, Homburg, Carlsbad, and Marienbad for this purpose, in addi-

tion to the general ones just referred to. Sulphur waters may be expected to have more or less effect in the direction of drying up the expectoration, but they are much more valuable for general treatment. In this country we find them in the White, Red, and Salt Sulphur Springs of Virginia, Richfield, Sharon, and many others. Abroad, Harrogate, Aix-les-Bains, Cauterets, Eaux-Bonnes, and Baréges are recommended.

The character of the expectoration also largely determines the choice of climate for chronic bronchitis. To reduce expectoration dry climates should be selected; to increase it moist places should be chosen. The dry forms are best treated in Algiers, Corsica, Cannes, Nizza, Mentone abroad; in this country the coast of Florida and Southern California are of great service. In cases with moderate secretion the interior of North or South Carolina, Georgia, or Florida may be chosen. In the very moist forms the desert in Egypt or Algiers is highly recommended; in this country Montana, Wyoming, Colorado, northern New Mexico, western Kansas, southern New Mexico, and southern Arizona. Everything else being equal, we may expect complete cessation of expectoration by removal to the proper climate, therefore change from a progressive to a stationary condition and perhaps in some instances complete cure. The details for choice of climate are the same as in any other disease, and in addition to control of expectoration it should be modified by considerations in other directions, as in any other disease in a given individual.

The treatment directed with expectoration and cough as a guide not only gives relief, but prevents further development of anatomical lesions. If in addition to this we could remove the anatomical lesions produced by the chronic bronchitis and return the tissues to their normal condition we could control the whole situation. This is not possible, but something can be done. In this connection it is necessary to consider the administration of iodine and its compounds, the action of which in the human body is not thoroughly understood, but the effects of which are thoroughly appreciated by clinicians. As a result of clinical observations we have taken for granted that the administration of iodine is followed by distinct effects upon glandular structures, as well as upon some of the consequences of inflammation. The former action, I believe, has not been assailed; it is certain that in so far as the lesion of chronic bronchitis is confined to glandular hypertrophy and infiltration, the disease may be cured by the consistent administration of iodine. In some degree the changes in the bronchial wall resemble those of arteriosclerosis, as there is destruction of elastic and muscular tissue and substitution of fibrous tissue for them. We may look upon the therapeutic problem as possessing the same terms; we try to reduce connective tissue and increase elasticity and muscularity of the bronchial walls. That this follows the proper administration of iodine in arterio-

sclerosis as well as in chronic bronchitis is certain. How it occurs is not proved. Müller and Inada, working with Römberg (1904), showed that potassium iodide reduces the viscosity of the blood. Aside from the fact that this would not explain most of the changes following the administration of iodine, Determann, working with more accurate methods, failed to verify this observation. Rumpf states that iodine does not act by causing absorption, and as this view is in direct opposition to all our experience, more evidence than a mere statement should be adduced until it can be entertained. It is true there is little experimental evidence one way or the other, although Scharz (1908) has shown that by pencilling the edges of aseptic wounds with iodine very small cicatrices are left; in other words, iodine causes absorption of newly formed connective tissue. But absorption follows the use of iodine in various conditions of connective tissue formation (non-syphilitic), in brain tumors, in inflammatory results in the eyes, the ears, the joints, indeed—wherever fibrous tissue is found adventitiously. How this is done is not understood, but the fact that Huchard's views of dilatation of bloodvessels by iodides are being reestablished, with the peculiar vascular conditions existing in newly formed connective tissue, increased blood supply might account for absorption of tissue, which impedes activity of elastic and muscular tissue in the bronchial wall merely by its presence. That the iodides act only by causing increased expectoration in chronic bronchitis is refuted by the observation that they are of great value when the expectoration is already increased. But in order to get good effects from iodine it should be given as we give it in arteriosclerosis, for a long time, from one to two years, the dosage to be controlled by the physiological effects. Any preparation of iodine may be given, and the choice frequently depends upon the so-called idiosyncrasies of the patient. Whenever it is possible the iodides should be given in chronic bronchitis, as they are followed by better results than pure iodine.

Much may be accomplished by drugs, as has been stated. Equally as much may be attained in the same direction by the proper employment of exercises and gymnastics. In order to do this we should bear in mind precisely what we wish to accomplish and then try to formulate directions which will help us to gain the desired results. For chronic bronchitis, before great structural changes have taken place these results have already been described. The formula for producing these effects is a very simple one—*increase expiration*. In increasing expiration the lungs and bronchi are contracted. For our present purposes circulation is changed at this time, for during expiration blood pressure is increased, and, as Kronecker and Heinrichs have shown, a greater amount of blood flows to the right heart during expiration. With increased circulation stasis is removed, and with it many of the pathological conditions of chronic bronchitis. Contraction of the bronchi during expiration favors expectoration,

as accumulated secretion in glands is pressed out of the mucous membrane into the lumen of the bronchi and is followed by an increased cough reflex. Nutrition of the various coats depends largely upon contraction of the bronchi; the veins are depleted and the lymphatics are emptied. When expiration is increased, the normal effects of it are increased; moreover, certain new effects are produced in pathological states which are valuable for therapeutic purposes. There is a distinct effect tending to diminish glandular and cellular infiltration, probably also existing connective tissue. Exercise of involuntary bronchial muscle takes place with the same results that follow this procedure in the myocardium. When the organic changes existing have been diminished the possibility of regeneration of elastic tissue must be taken into consideration. This occurs much more frequently than is conceded, a fact confirmed by Jores' statement that all fibroblasts can produce elastic tissue.

How can all this be accomplished? Knopf has called attention to the fact that many people do not understand how to breathe properly or they breathe paradoxically, that is, the upper part of the thorax expands while the lower part does not, because the abdominal muscles contract during inspiration. The importance of removing this form of breathing by education immediately suggests itself for chronic bronchitis, and much stress is laid upon it by Knopf in this connection. It is very easy to teach patients to increase expiration, and the quantity of increase may be increased or diminished. The simplest form is to ask the patient to take full inspirations, which should be followed by full expirations. In doing all of these respiratory gymnastics the patient should breathe fresh air, always breathe in through the nose and breathe out through the mouth, for as the chink of the glottis is normally diminished during expiration, less resistance follows mouth than nose expiration. More effect than is produced by simple inspiration and expiration follows elevation of the arms during inspiration followed by expiration with the arms at the side. There is added flexion of the lower extremities with expiration. In order to produce still greater effects upon expiration, the lower part of the thorax should be compressed manually during each expiration in combination with one of the first movements. The latter, that is, compression of the thorax, which was first introduced by Gerhardt, is very valuable in helping expectoration. These movements should not be done more rapidly than the normal respiratory rate, 18 times per minute. Exercise of the abdominal muscles by voluntary contraction may also be tried, and in some instances it is very valuable. Passive movements by massage, electricity, or by the aid of apparatus may be valuable in individuals, as much by the mental as the physical effects which follow them.

It is impossible to discuss the theoretical and practical aspects of pneumatic apparatus within the limits of this article. Since their reintroduction about thirty-five years ago a large literature has

developed, which comprises all possible refinements of thought, reason, ingenuity, and, at times, credulity. It may be freely stated that pneumatotherapy is still used extensively; furthermore, that good results sometimes follow its application. My own experience leads me to believe that the practitioner does very well without it, an opinion which seems verified by the disappearance of pneumatic apparatus from the offices of physicians.

OPEN-AIR AND HYPEREMIC TREATMENT AS POWERFUL AIDS IN THE MANAGEMENT OF COMPLICATED SURGICAL TUBERCULOSIS IN ADULTS.¹

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THERE are some localities in the body in which bone tuberculosis, though operable, cannot be cured by operation alone. Tuberculous affection of the os sacrum is one type of this class of cases; that of the pelvis, such as acetabulitis complicated with suppurating coxitis, another. The persistent sinuses following excision of the hip-joint often baffle the surgeon's skill and patience.

Cold abscess formation as a result of tuberculosis of the pelvis, especially if recurring again and again, is always a grave complication, and particularly so in adults. It is true, much can be accomplished nowadays by filling the cold abscess cavity, after evacuation of the pus through a trocar, with iodoform emulsion (best iodoform suspended in sterilized glycerin), and following this process by the faithful and persistent use of hyperemia for the diseased bone or joint. Still, there are cases that resist all our efforts in this direction. It is in these cases that additional open-air treatment may become the means of saving limb or life.

The literature in this respect, at least in so far as the treatment of older patients is concerned, is rather meagre. Halstead, of Baltimore, in 1905, read a paper at the first annual meeting of the International Association for the Study and Prevention of Tuberculosis, on the Results of the Open-air Treatment of Surgical Tuberculosis, in which he set forth the beneficial influence of fresh-air treatment in tuberculous bone affections, and gave his personal experience with the method. What has been accomplished in the young with this method is well-known. The reports issued by the

¹ Read at a meeting of the Section on Surgery and Orthopedics of the International Congress on Tuberculosis, Washington, D. C., October, 1908.

various seaside resorts abroad, as also the Sea-breeze Hospital in Coney Island, maintained by the New York Association for Improving the Condition of the Poor,² furnish ample proof in this direction.

The following three cases selected from a number that have come under my care within the last few years will serve to illustrate the point in question.

CASE I.—*Tuberculosis of the os sacrum, involving both ilio-sacral joints and the fifth lumbar vertebra with its articulation.*

Mr. X. Y., aged forty years, who had suffered from repeated slight attacks of hemorrhage from the lungs during the last few years, came under my care in April, 1906, on account of a cold abscess over the left iliosacral joint. The os sacrum was swollen and tender in its upper part, as was also the neighboring pelvic bone. In view of the patient's reduced general condition, more serious operative intervention could not be considered at the time. The abscess was evacuated under local ethyl-chloride-cocaine anesthesia and then filled with a 5 per cent. emulsion of sterilized iodoform-glycerin. There was little reaction. The patient was put on a nourishing diet and remained under the care of a nurse. Three weeks later, and again four weeks thereafter, the procedure had to be repeated, as the abscess had refilled. Soon afterward a discharging sinus formed. As the patient had large business interests at stake, and time was an important item, excision of the iliosacral articulation was seriously considered. However, increasing swelling and tenderness of the right (opposite) iliosacral articulation rendered operative work out of question. There could be no doubt that the entire upper part of the os sacrum was involved in the disease.

In former times, such a patient was usually doomed. Today we have learned that conservative methods of treatment may yet at times accomplish a cure in these cases. Fortunately, the patient belonged to that class that need not count the cost in trying to regain health. Accompanied by a nurse, he was sent to the mountains, where he was so fortunate as to come under the care of a most thorough and learned colleague. He was kept on his back, lived in the open day and night, was put upon a forced diet, and had general massage and proper internal medication. A typical tuberculous affection of the sheath of the left Achilles tendon, which had developed within a comparatively short time, was regularly subjected to hyperemic treatment with the elastic bandage around the thigh.

After four months he had gained almost forty pounds, and had to change his diet in order to reduce his weight. The neighborhood of the sinus was tender, as before, and the opposite sacro-iliac articulation. Now hyperemic treatment by means of suction glasses was added. Regularly every day a large oval glass globe, covering the upper part of the os sacrum and both sacro-iliac articulations, including the

² Medical Record, March 7, 1908.

immediate surroundings, was employed six times for five minutes, with three-minute intermissions. Half a year later the sinus had closed for the first time. It reopened and healed temporarily in the course of the following two months. But since the spring of 1907 the scar has formed permanently, proving beyond a doubt that the local tuberculous bone disease had healed. No better proof could be rendered for the deep effect of suction hyperemia.

Meanwhile pain and tenderness over the sacrovertebral joint and fifth lumbar vertebra itself had appeared. Slowly a large cold abscess developed in the right lumbar region, the side opposite to that originally evacuated. It is very probable that the hyperemic treatment caused this breaking down of the tuberculous infiltration, which, in the light of Bier's teachings, is to be looked upon as a favorable sign. Slowly the pus travelled downward along the iliopsoas muscle. When the patient came to the city for surgical treatment, in May, 1907, a typical large cold abscess could easily be made out above the upper half of Poupart's ligament. Its development could be explained in no other way than by assuming that the sacrovertebral articulation, as well as the body of the fifth vertebra, had become complicated in the disease. Typical clinical symptoms corroborated this diagnosis, which was also concurred in by a prominent orthopedic surgeon who was consulted at the request of the family.

On June 7 the abscess was tapped under local anesthesia, injury to the pelvic artery being fortunately avoided. More than a quart of thin pus was evacuated through the trocar cannula, and 100 c.c. of a 5 per cent. sterilized iodoform-glycerin emulsion injected in its place. Three weeks later the process had to be repeated; a great deal of the fluid had re-accumulated. Of course, the general treatment in all its details, including suction hyperemia, the latter now also over the lower portion of the lumbar spine, was strictly and regularly carried out, and the hypodermic application of tuberculin (Beranek's preparation), which had been begun several months before, was continued in increasing doses. Furthermore, a leather corset supported by steel bands was procured. This was at first worn continuously, the only time of interruption being during massage and cupping. Later on, the corset was left off at night. The abdominal posture was much favored by the patient. Early in July he returned to the mountains. When seen by me there in September, the abscess had re-filled to such a small extent that aspirating, though I came prepared to do so, was not done, it being deemed wiser to trust to spontaneous absorption. At this time the bacilli in the sputum had entirely disappeared; in fact, it had been impossible by the most careful search to detect them for over a year. But the patient complained of frequent accumulation of mucus in the throat and trachea. The regular use of Kuhn's lung suction mask, which latter I had at that time imported for the

patient from Germany, was then added as another link in the chain of our conservative method of treatment in this case. As is well known, this mask was designed for the purpose of subjecting the lungs to suction hyperemia according to Bier's principles.

Faithfully the mask was used by the patient, who has always helped along energetically his attendants' efforts to effect a cure, and is impatiently waiting for the verdict "cured," so that he may return to business. The mask has been applied for one hour twice daily up to the present time. The accumulation of mucus and the slight hacking cough have disappeared. The localized tuberculosis within the sheath of the left tendo Achillis also has completely subsided.

At the time of writing these lines the patient is in excellent condition. He has returned from the mountains. If no unforeseen setback occurs, the hope may be confidently entertained that another year, carefully spent with no other aim but to get well, will suffice to restore the patient to complete health. Surely, this is a most gratifying result obtained by means of conservative treatment along modern lines in a hitherto intractable tuberculous affection.

CASE II.—*Recurrent tuberculous inflammation of the tibiotarsal joint after astragalectomy combined with extirpation of the synovial membrane. Cured by means of hyperemic treatment.*

R. E. Mc.M., male, aged sixteen years, consulted me in February, 1906, for a typical inflammation of the right tibiotarsal joint. The patient is a slim, tall, anemic young man. His father has phthisis. The x-rays show a typically diseased astragalus as the cause (sequestrum).

In view of the rather limited means of the family, and the excellent results obtainable in these cases by operation, conservative treatment was not favored. In February, 1906, the joint was opened according to Koenig's method. The astragalus was removed, the much diseased synovial membrane carefully extirpated, and a special incision added for drainage of the joint on the outside near the tendo Achillis. The three wounds were left wide open and the cavity was filled with iodoform gauze. The first dressing remained undisturbed for two weeks.

Early in June the patient was discharged with his wounds closed and excellent motion. Still, he was not permitted as yet to use the extremity. Equipped with crutches and the elastic bandage, which he had learned to apply during the hyperemic after-treatment, he soon left for Colorado. He improved rapidly. Next spring found him horse-back riding. In May he unfortunately severely sprained his foot. Pain and tenderness set in and several abundantly discharging sinuses resulted. I sent him a set of suction cups and a new elastic rubber bandage for hyperemic treatment of the foot without allowing him to use the latter. Full directions were given and changed from time to time according to the course of the trouble. Six months later all wounds had closed, and the pain and tenderness

subsided. He was again warned against putting any weight upon the foot for some time. He is at the present time still using the artificial hyperemia.

A recurrent trouble like this would formerly have required prompt surgical attendance; several secondary operations might have become necessary, and in case of a serious turn of the accident even amputation of the leg might have had to be resorted to. Fortunately, this patient—far removed from direct medical aid as he was; he had moved to a camp in Wyoming—had sufficient intelligence properly to carry out the treatment on basis of directions given from here. This case represents another striking illustration of what fresh air in conjunction with careful and persistent hyperemic treatment can accomplish in a comparatively short time. It also demonstrates how careful a patient with a recently healed tuberculous trouble should be to avoid traumatism to the part.

CASE III.—*Tuberculosis of the right hip-joint with multiple sinus formation. Disarticulation at the hip-joint; involvement of the pelvis. Alive after ten years of out-door life. Hyperemic suction treatment for persisting sinuses; steady improvement.*

On November 8, 1897, I performed disarticulation at the right hip for a long-standing suppurative tuberculosis of the joint at the German Hospital in F. B., a man, aged thirty-six years. He had seen many physicians and tried everything imaginable. The entire upper half of the femur was complicated in the disease and the soft parts were riddled with discharging sinuses. Total removal of the lower extremity gave the only hope of relieving his condition. This was carried out with intra-abdominal compression of the common iliac artery, through an intra-muscular incision, according to the McBurney method, which worked admirably; there was very little loss of blood.³ Unfortunately, it was seen, after the acetabulum had been fully exposed following the removal of the extremity, that the pelvis, too, was extensively invaded by the disease. The greatly run down, anemic condition of the patient forbade immediate additional resection of the iliac bone. A few months later, when the patient had sufficiently recovered, this second operation was proposed to him, but he absolutely refused further operative treatment. He asked me what else he might do to prolong his life. I advised him to buy a place at the seashore, live there all the year around, and stay in the open air as much as possible. We had to select the seashore instead of the mountains, as the patient, being dependent on his business, wanted to go to the city regularly as long as his condition would permit. I then lost track of him, and was greatly surprised when in April, 1908, I was requested by a colleague to see this patient with him in a Long Island seashore place. I had considered him long dead and gone. Instead, I found a still very anemic man, who, up to a few days ago, had gone to the

³ *Annals of Surgery*, 1898, xxviii, 131.

city regularly winter and summer attending to his business, having become quite prosperous. He wanted my advice regarding some pain he had in the region of the symphysis—a new feature in his trouble. On looking him over and comparing his present condition with that of ten years ago, I found that quite a number of sinuses had closed, while others still remained open, and extended deeply into the pelvis. He had then packed day after day with yards of narrow strips of gauze by his faithful wife, who had tenderly nursed him all these many years. His lungs were not affected. Urinary examination showed absence of albumin.

I advised that the packing be stopped and Bier's suction cups used instead, giving the necessary directions. Again I deeply regretted our present inability to produce obstructive venous hyperemia—the kind that is required for the treatment of tuberculous affections—in the bones of the pelvis and hip-joint. Today, three months later, the discharge from the sinuses has greatly decreased, his pains have disappeared, and his general health, too, is decidedly improving.

Pondering over this case, I have been much impressed by the salubrious effect of open air in what seemed to me an absolutely hopeless case.

These three patients were private patients of mine. They were able to spend more or less money in an effort to regain their health. But how about the masses, the hopelessly poor? No adult patient afflicted with chronic suppurative tuberculous bone disease, nor even one with a slightly discharging persistent sinus, will gain admission to any of our many country sanatoriums. The latter are thus far designed for internal tuberculous affections exclusively, that is, consumption—not for surgical cases. How great an amount of good could be done if provision were made by the State and by our wealthy philanthropists, who have built and are supporting these institutions, to allow also the poor sufferers from surgical tuberculosis to obtain the benefit of this all-important remedy for them: fresh air.

I would, therefore, close my remarks with the plea that, for the present, two special wards—male and female—be set aside for surgical cases in all country sanatoriums for consumptives, and that the special position of surgical assistant be created. It is self-understood that such colleague would have to be a man of hospital training and fully conversant with Bier's hyperemic treatment. This arrangement would have to be continued until the State or philanthropists had separate sanatoriums erected exclusively for the conservative treatment of adults suffering from surgical tuberculosis. I plead for separate sanatoriums, for the reason that the majority of these patients are not afflicted with complicating tuberculous affection of the lungs. If a number of private rooms were set aside in such sanatoriums for surgical tuberculosis, the income derived from this source would be a material help in defraying running expenses.

THE HEART IN PULMONARY TUBERCULOSIS.

II. THE HEART ITSELF DISEASED.

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IN a former paper¹ that section of this study which deals with the heart in pulmonary tuberculosis when the heart itself is not diseased was dealt with. In this section it is purposed to discuss the heart in pulmonary tuberculosis when the heart itself is diseased. In discussing this subject an endeavor has been made to separate patients developing cardiac disease during pulmonary tuberculosis from those developing pulmonary tuberculosis during cardiac disease.

CARDIAC DISEASE DEVELOPING DURING PULMONARY TUBERCULOSIS.

Heart disease developing during pulmonary tuberculosis may be found in the order of its frequency, in the pericardium, the endocardium, or the myocardium.

MYOCARDITIS AND CHANGES IN THE MYOCARDIUM. (A) *Non-tuberculous*. Changes in the myocardium are not infrequent at autopsy, but difficult to diagnose clinically. They are very rarely tuberculous in nature and consist of fatty degeneration, fragmentation of the myocardium (v. Leyden²), hypertrophy of the muscle nuclei (33 times in 47 cases at the Phipps Institute³), brown induration, and interstitial myocarditis. In 12 of these 47 cases the heart muscle was normal, and in none was tuberculosis found. Klippel⁴ has described a generalized amyotrophy with hyperexcitability of the myocardium in particular, resulting in tachycardia. The fatty degeneration, which is frequent according to De Renzi,⁵ may follow this muscular atrophy (Birch-Hirschfeld⁶). Unless the pericardium also be affected, these changes often pass undetected, but when cyanosis, edema, dyspnoea, and a frequent and irregular small pulse occur, such changes are very probable. Adynamia is not common and occurs usually only late in fibrosis. Attacks resembling pseudo-angina pectoris, Kidd⁷ believes, are coincidences. The

¹ AMER. JOUR. MED. SCI., 1908, cxxxvi, 819.

² Deut. med. Woch., 1896, xxii, 1, 19.

³ Third Annual Report, Phila., 1907, p. 165.

⁴ Des amyotrophies dans les maladies générales chroniques et de leurs relations avec lésions des nerfs périphériques, Thèse, Paris, 1889. (Quoted by Sequer, Le cœur des tuberculeux, Thèse, Paris, 1903.)

⁵ Path., Sympt., u. Behandl. d. Lungenschw., Wien, 1894, p. 197.

⁶ Centrabl. f. allg. Path., 1891, ii, 807.

⁷ Allbutt's System of Medicine, 1901, v, 214.

great increase in weight that some patients exhibit who are kept perfectly quiet must at times affect the heart, which shows unmistakable signs of weakness, due, possibly, to a fatty infiltration.

(B) *Tuberculous.* Tuberculosis of the myocardium is very rare, occurring about once in 1000 autopsies on tuberculous subjects (Valentin⁸). It is said to occur most frequently as miliary tuberculosis, much less often as large solitary tubercles, diffuse tuberculous infiltration with scattered caseating areas, or more rarely still as a diffuse tuberculous fibrosis without caseation. These changes seldom produce functional disturbances, occur more frequently in early life (under fifteen), and have never caused rupture or aneurysm of the heart (due possibly to the low blood pressure). The larger nodules may be single or multiple, occur more often in the ventricles (left more than right) than the auricles (right more than left), and rarely ulcerate. The disease usually extends by direct continuity from the pericardium (23 out of 30 cases, Stephani⁹) or endocardium (8 out of 20, Stephani¹⁰) into the myocardium, but may arise from infection from the lymph or blood stream. It has little clinical significance, and is practically never diagnosticated except post mortem.

PERICARDITIS. The pericardium is said to be more frequently attacked in tuberculosis than the endocardium or the myocardium. In 1780 autopsies upon tuberculous subjects, all with pulmonary involvement, tuberculous pericarditis was found, according to Norris,¹¹ 82 times, and if to these be added 31 instances in which no etiological factor was found, and in which he thinks tuberculosis was probably the cause, tuberculous pericarditis occurred in 6.3 per cent. Billings¹² believes that fully 50 per cent. of all cases of pericarditis are overlooked clinically, and Kidd¹³ that the condition is rarely diagnosticated during life. The reports of the Phipps Institute¹⁴ fully bear this out and emphasize the fact that the symptoms are usually very obscure and overlooked. But one case is mentioned clinically in 2999, and 16 were found in 160 autopsies. In 1300 patients at the Adirondack Cottage Sanitarium no symptoms suggesting pericardial involvement occurred except once when a temporary pericardial friction rub was noted in a far advanced case. Norris,¹⁵ in 7646 collected cases of pulmonary tuberculosis, found 31 instances of pericarditis (0.4 per cent.). It is more frequent in childhood, and Rilliet and Barthel¹⁶ found it in 3.2 per cent. of 312 tuberculous subjects.

⁸ Contribution a l'étude de la tuberculose myocardique, Thèse, Paris, 1894.

⁹ Beit. z. Klin. d. Tub., 1903, i, 387.

¹⁰ Loc. cit.

¹¹ Univ. Penna. Med. Bull., 1904, xvii, 155.

¹² Jour. Amer. Med. Assoc., 1901, xxxvii, 1503.

¹³ Loc. cit.

¹⁴ Second Annual Report, Phila., 1906, p. 34; and Third Annual Report, Phila., 1907, p. 45; Third Annual Report, p. 161.

¹⁵ Loc. cit.

¹⁶ Handb. d. Kinderk. Translated by Krupp, Leipzig, 1844, iii, 230.

The frequent involvement of the pleura would suggest a more common occurrence clinically of pericarditis, as Thym¹⁷ found in 53 out of 94 cases of pericarditis extension from the pleura, but the rarity with which the mediastinal glands are attacked in pulmonary tuberculosis may, in part, account for this. Infection may, of course, take place through the blood stream. Tuberculosis ranks next to rheumatism in the etiology of pericarditis.

The pericarditis may be either dry or, as is more frequent, exudative, and Thayer¹⁸ has reported a case in which 4000 c.c. of fluid was found in the pericardium. The exudate is usually serofibrinous, and if hemorrhagic is not indicative of tuberculosis (Norris,¹⁹ Holt²⁰). Bertaux²¹ calls attention to the facts that in instances in which the effusion reaches 1000 c.c. it is almost always hemorrhagic, and the real condition is often revealed first by an *x*-ray examination. Tubercle bacilli are often found with difficulty. Norris²² found the chronic oblitative form the most common, and Osler²³ has drawn attention to the fact that a simple oblitative pericarditis, while depending upon the tuberculosis, is not necessarily tuberculous itself. Men are more frequently affected than women. A tuberculous pulmonary cavity may, in very rare instances, perforate into the pericardium, producing pneumopericarditis. The occurrence of pericarditis would naturally aggravate the symptoms of the pulmonary tuberculosis, and the prognosis is unfavorable.

Lanos²⁴ has described a cardiotuberculous cirrhosis, which occurs most frequently in boys under twenty years of age. The tuberculous disease starts in the mediastinal glands and spreads by continuity to the heart. Cyanosis, embryocardia, absence of precordial shock, and later, ascites, œdema, and other symptoms referable to the liver occur, which lead to a diagnosis of hepatic cirrhosis. The disease is usually fatal.

ENDOCARDITIS. Clinically endocarditis is found associated with pulmonary tuberculosis much more frequently than pericarditis, but at autopsy it is less frequent. In 8154 autopsies collected by Norris²⁵ valvular disease was present 293 times (3.5 per cent.). The records of 60,428 patients with pulmonary tuberculosis at the German and Swiss sanatoriums and from some private sources (Anders,²⁶ Norris,²⁷ etc.) show that valvular disease occurred in 625 (1 per cent.), and in 10,687 other records from the same sources heart disease was stated to be present in 131 (1.2 per cent.). Col-

¹⁷ Ueber gleichzeitige Tuberkulose der Lungen und des Herzbeutels. Inaug. Dissert., Jena, 1897.

¹⁸ Tuberculous Pericarditis. Maryland Med. Jour., 1903, xlv, 123.

¹⁹ Loc. cit.

²⁰ Diseases of Infancy and Childhood, New York, 1906, p. 619.

²¹ La péricardite tuberculeuse a grand épanchement, Lyon, 1906.

²² Loc. cit.

²³ Quoted by Norris, loc. cit.

²⁴ De la cirrhose cardio-tuberculeuse chez l'enfant, Thèse, Paris, 1904. (Abstract in Rev. de la Tub., 1904, i, 427.)

²⁵ AMER. JOUR. MED. SCI., 1904, cxxviii, 649.

²⁶ AMER. JOUR. MED. SCI., 1902, cxxiii, 93.

²⁷ Loc. cit.

lectively we have 71,115 patients with pulmonary tuberculosis, of whom 656 (and possibly 44 more) (0.9 per cent.) had some disease of the heart or of its valves. While not all, the vast majority (90 to 95 per cent.) were almost certainly endocardial lesions, and the remainder comprise so small a number as to have no practical effect upon the gross figures. No attempt, of course, has been made in these figures to separate patients with recent endocarditis, secondary to pulmonary tuberculosis, from those with endocarditis, in whom pulmonary tuberculosis has developed. Evidently here, too, many instances of the cardiac disease are overlooked clinically.

Endocarditis in pulmonary tuberculosis may be due to secondary organisms, to the tubercle bacillus, or possibly, as Teissier²⁸ insisted, to the tuberculous toxin. While the lymphatic tissue is frequently affected in tuberculosis and the tonsils not spared, yet it is a striking fact, long pointed out, that acute articular rheumatism or rheumatic fever, notwithstanding life in the open in all sorts of weather, is exceedingly rare. I have seen but one typical instance in over 3000 tuberculous patients. On the other hand, a point which will be referred to later, a history of rheumatism in tuberculous patients who present signs of endocarditis is very common. Anders mentions that Kidd²⁹ found, in 12 patients out of 27 with endocarditis, a history of rheumatism, and it was present in 4 of my 7 cases. Many tuberculous patients suffer from slight myalgia and joint pains which, in regard to etiology, are difficult to diagnosticate. Poncet³⁰ has repeatedly called attention to a form of tuberculous rheumatism, and, if many of these patients had this disease, then it can be stated confidently that tuberculous rheumatism is far less often accompanied by endocardial changes than rheumatic fever.

Endocarditis occurring during pulmonary tuberculosis is most often a late complication, and so passed by. I have no recollection nor any definite record of endocarditis developing in a patient with pulmonary tuberculosis. Norris,³¹ from 11,655 autopsy records from all sources, found recent endocarditis noted in 151 (1.3 per cent.), and Marshall³² states that acute endocarditis is present in 5 per cent. of all patients with pulmonary tuberculosis. It is of interest to note the frequency of endocardial changes in dogs with experimental tuberculosis. In a series of 6 dogs, inoculated intravenously and treated by zomotherapy, endocarditis was found 4 times, and in 1 of these hemorrhagic pericarditis was present (Brown³³).

Owing to the great frequency of healed latent pulmonary tubercu-

²⁸ Des lésions de l'endocarde chez les tuberculeux, Paris, 1894, p. 67.

²⁹ St. Bartholomew's Hosp. Reports, 1887, xxiii, 239.

³⁰ Cong. français de chir., 1897, xi, 732; Gaz. hebdom. de méd. et de chir., 20 juillet, 1902, p. 673.

³¹ Loc. cit.

³² Johns Hopkins Hosp. Bull., 1905, xvi, 303.

³³ AMER. JOUR. MED. SCI., 1903, cxxv, 1071.

losis among the general population, Marshall³⁴ thinks the two diseases are often thus associated, although the pulmonary tuberculosis is of no clinical significance and the association of no importance.

Tuberculous Endocarditis. True tuberculous endocarditis is very rare, and many instances reported as such, as Marshall³⁵ has pointed out, cannot be accepted. The endocardium reacts macroscopically alike to all organisms and the vegetations present no distinguishing features (Braillon³⁶). Tubercle bacilli are not infrequently in the blood in tuberculosis, as Jousset,³⁷ Luedke,³⁸ Liebermeister,³⁹ and others have demonstrated. That these circulating tubercle bacilli should lodge on the valves affected by a preëxisting endocarditis is not improbable, and besides the presence of tubercle bacilli, true tuberculous changes must be present in the vegetations, or if only miliary tuberculosis occur, they must lie, as Benda⁴⁰ has shown, above the elastic membrane to justify a diagnosis of tuberculous endocarditis. When this test is applied, fewer instances of tuberculous endocarditis are found.

Tuberculous endocarditis may be divided into (1) miliary, (2) true tuberculous endocarditis, (3) endocarditis due to extension from the myocardium, and (4) endocarditis due to extension from an organizing tuberculous thrombus (Marshall⁴¹). The miliary type is the most frequent, and occurs generally in connection with miliary tuberculosis. Braillon⁴² believes that the course of tuberculous endocarditis can be divided into two periods, the first, virulent, resembling septicemia, during which tubercle bacilli are contained in the blood, which may facilitate diagnosis, and second, a period during which the lesion tends toward healing and sclerosis. Tuberculous endocarditis is, however, so rare as to have no clinical significance, and has seldom been diagnosed ante mortem, as it may occur without producing murmurs, and the fever accompanying it is attributed to the pulmonary tuberculosis. It may be nodular, caseating, or vegetating, and has been produced experimentally in rabbits (Michaelis and Blum⁴³).

Endocarditis due to secondary organisms may occur, or recur, from an old lesion, is usually acute, vegetating, rarely ulcerative, and resembles closely an ordinary endocarditis. Marshall,⁴⁴ who found acute endocarditis in 5 per cent. of patients with pulmonary tuberculosis, would place here the majority of these cases.

Mitral Stenosis. Teissier⁴⁵ has described as very common (40 per cent.) a sclerotic valvular endocarditis, due to a slowly acting

³⁴ Loc. cit.

³⁵ Loc. cit.

³⁶ Rev. de la tub., 1904, i, 254.

³⁷ Cong. Int. de la Tub., 1905, i, 428.

³⁸ Wien. klin. Woch., 1906, xix, 949.

³⁹ Int. Centralbl. f. d. gesamte Tub., Forschung, 1907, ii, 36.

⁴⁰ Lubarsch and Ostertag, Ergeb. d. allg. Path., etc., 1898, v, 155. Berl. klin. Woch. 1899, pp. 566, 596, 646.

⁴¹ Loc. cit.

⁴² Loc. cit.

⁴³ Deut. med. Woch., 1898, xxiv, 550.

⁴⁴ Loc. cit.

⁴⁵ Des lésions de l'endocarde chez les tuberculeux, Paris, 1894, xxx, 59.

tuberculous poison, which some believe is comparable to the ether extract, obtained by Auclair⁴⁶ from the tubercle bacillus. The valve usually affected is the mitral, and the lesion produced stenosis, which, as I shall mention later, has some retarding effect upon the pulmonary lesion. It is said to occur rarely as the primary disease, and to be more inhibitory to pulmonary tuberculosis than any other form of cardiac disease. Warthin⁴⁷ accepts this form of endocarditis, but does not accept toxemia as the cause. Chartier,⁴⁸ however, holds that the sclerosis is an index of resistance to the tuberculosis, and Potain⁴⁹ states that it never occurs in acute but frequently in fibroid forms of pulmonary tuberculosis. Pure mitral stenosis, according to Malmonte,⁵⁰ is more often the manifestation than the cause of an attenuated bacillosis, which expresses itself in the form of lupus, arthritis, or various hereditary manifestations (chlorosis, scrofulosis, etc.).

Thrombi. Thrombi in the right ventricle are rarely, if ever, diagnosed ante mortem. They rarely occur in acute cases, but are usually found very late in chronic cases with marked cachexia, and are due to changes in the endothelium, to stasis provoked by the pulmonary lesion and hence practically always in the right ventricle, and to changes occurring in the blood, such as a lessened amount of blood, an increased amount of fibrin, fewer erythrocytes, less hemoglobin, leukocytosis, lessened alkalinity, and the presence of tubercle bacilli (Barie⁵¹). Warthin⁵² found thrombi in 10 per cent. of his tuberculous patients. A number of instances have been reported in which the thrombus had organized, and tubercle bacilli and caseation were found in the thrombus, in some cases extending into the endocardium. Barie⁵³ says the symptoms are obscure, but a sudden onset of dyspnoea with crises of suffocation and a tumultuous heart action, without signs in the pleura or lungs to explain it, is very suggestive. Syncope or pulmonary apoplexy (embolism) may occur. Slighter forms of pulmonary embolism are often diagnosed as infarcts, or overlooked entirely, especially in the moribund (Kidd⁵⁴).

PULMONARY TUBERCULOSIS DEVELOPING DURING CARDIAC DISEASE.

The great frequency of pulmonary tuberculosis makes it probable that, other things being equal, a large number of patients with heart disease should also have pulmonary tuberculosis. The greatest age incidence in pulmonary tuberculosis is, roughly speaking, between the twentieth and fortieth years, while for heart disease the

⁴⁶ Médecine moderne, 1901, xii, 118.

⁴⁸ Rev. de la tub., 1904, i, 41.

⁵⁰ Tuberculose pulmonaire et rétrécissement mitral pur., Lyon, 1905.

⁵¹ Jour. d. Praticiens, 1904, xviii, 257.

⁵³ Loc. cit.

⁴⁷ Buck's Ref. Handb. of Med. Sci., iv, 602.

⁴⁹ Quoted by Norris, loc. cit.

⁵² Med. News, 1899, lxxiv, 453.

⁵⁴ Loc. cit.

most frequent period is either earlier or later. So it is seen that the age incidences of the two diseases do not exactly coincide.

The extreme rarity of primary tuberculous carditis renders discussion of this condition of little practical value and makes the occurrence of secondary pulmonary tuberculosis purely problematical. Primary non-tuberculous pericarditis is often latent and may be of short duration; the occurrence of secondary pulmonary tuberculosis has received and deserves scant consideration. Two patients, both of whom have made good recoveries, gave a history of an attack of "pericarditis" before entrance to the Adirondack Cottage Sanitarium.

ENDOCARDITIS. The main interest in pulmonary tuberculosis secondary to cardiac disease is in connection with endocarditis. In the vast majority of all cases in which these two diseases are associated, I believe that the cardiac disease is clinically, at least, the primary. This statement may be contrary to that held by some observers, but in over 3000 patients, who have been more or less closely followed for a number of years, I have yet to see an instance in which undoubted valvular disease developed in a patient with pulmonary tuberculosis. The great frequency of pulmonary tuberculosis, and its early incidence, makes it more probable that it is usually pathologically the primary disease, but certainly a smaller percentage of patients with cardiac disease present signs of pulmonary tuberculosis than are found in the general population. Consequently, when Rokitsansky⁵⁵ says that persons laboring under enlargement of the heart (dilatation, hypertrophy, and their complications), whether primary or superinduced by mechanical obstruction at its orifices, do not contract tuberculosis, he may be right, but if so, a number of these patients must have contracted it before the development of cardiac disease, and further, it does seem as if in some it retarded the development of the pulmonary tuberculosis. The cause of this is difficult to determine, but it is a well-known fact that when pulmonary tuberculosis becomes complicated with tuberculous disease elsewhere, the primary lung lesion often retrogrades or remains stationary, while the complication advances, and on the other hand, when the complication becomes less active, the primary disease may light up. Otto⁵⁶ believes that the cardiac disease prevents the spread of the pulmonary tuberculosis. It cannot be denied that implantation may occur, as Otto⁵⁷ holds, during a period when compensation fails and when poor nourishment of the heart does not enable it to keep up its work.

The frequency of the association of endocarditis and pulmonary tuberculosis has been previously dwelt upon, but it is interesting to note in passing that the percentage of endocarditis occurring in

⁵⁵ Manual of Pathological Anatomy, Swaine's translation for the Sydenham Society, 1854, i, 316.

⁵⁶ Virchow's Archiv., 1896, cxliv, 159.

⁵⁷ Loc. cit.

cases of pulmonary tuberculosis has been stated as from 0.1 to 6.4 per cent. Anders,⁵⁸ after excluding 29,000 cases of pulmonary tuberculosis out of 30,000, arrives at the conclusion that the approximately correct percentage is 3.13, but from the 71,000 cases previously mentioned, including Ander's,⁵⁹ the percentage was 0.9. From this it appears to me that about 1 per cent. of patients with pulmonary tuberculosis present signs of valvular disease. Of course, such statistics are open to criticism, and in some instances symptoms referable to the heart are unquestionably ascribed to the lungs, and the heart consequently examined in a cursory manner. But it must not be forgotten that the vast majority of these patients were in very early stages. At the Phipps Institute⁶⁰ 9 per cent. of 1009 patients were found clinically to have had valvular lesions, but no mention is made, so far as I could find, of the percentage of these that showed valvular disease at autopsy. Meisenberg,⁶¹ who has made a careful study of the records of 43,365 patients at Leipzig, found 1.75 per cent. with cardiac disease and 13 per cent. with pulmonary tuberculosis; 7 per cent. of the patients with cardiac disease had pulmonary tuberculosis and 1.14 per cent. with pulmonary tuberculosis had heart failure. Von Kryger,⁶² in 1100 autopsies on tuberculous subjects, found only 10 (0.9 per cent.) with cardiac disease, but in 59 autopsies on patients dead of marked cardiac disease, all had healed or arrested pulmonary tuberculosis. Frommolt,⁶³ in 7870 autopsies at Dresden, found valvular disease in 277, and of these, only 8 per cent. had pulmonary tuberculosis. Birch-Hirschfeld,⁶⁴ in 4359 routine autopsies, found pulmonary tuberculosis in 20.8 per cent., while in 107 autopsies on subjects with cardiac disease, pulmonary tuberculosis was found in 4.6 per cent. Norris,⁶⁵ who has collected the data of 8154 autopsies upon tuberculous subjects, found valvular disease present in 3.65, and in 388 autopsies on subjects with cardiac disease, pulmonary tuberculosis was noted in 6.7 per cent. It is difficult to explain the great differences among these figures, but if we recall the indifference with which tuberculosis has been treated at many general hospitals, and the reluctance some pathologists have for performing autopsies in apparently uncomplicated cases of pulmonary tuberculosis, the larger percentage of heart disease found by some pathologists may be readily explained.

Meisenberg⁶⁶ from his studies concluded that, given either disease, the other is less frequent than usual, and Anders believes that Graham's⁶⁷ figures tend to uphold this contention.

⁵⁸ Loc. cit.

⁶⁰ Second Annual Report, Phila., 1906, p. 239.

⁶¹ Ztschr. f. Tub. u. Heilst., 1902, iii, 329.

⁶² Inaug. Dissert., Munich, 1889 (1887). Quoted by Norris, loc. cit.

⁶³ Arch. f. Heilk., 1875, xvi, 238.

⁶⁴ Loc. cit.

⁶⁷ Montreal Med. Jour., 1896, xxv, 101.

⁵⁹ Loc. cit.

⁶⁴ Loc. cit.

⁶⁶ Loc. cit.

The question of sex in regard to this subject has been studied by Otto,⁶⁸ who believes that pulmonary tuberculosis is more frequently associated with cardiac disease in women than in men. Five of my 7 cases were in men.

The left side of the heart is affected in the vast majority of cases; in fact, the right side of the heart is rarely attacked. Congenital pulmonary stenosis, a very infrequent disease, forms a large percentage, 30 to 40 per cent. at least, of all the lesions found upon the right side of the heart.

Some difference of opinion formerly existed regarding the relative frequency of involvement of the mitral and the aortic valves, but now it is well recognized that disease of the mitral valve is more frequent than that of the aortic (5 to 2 in my cases), and both are more often affected singly than together. The more frequent occurrence of mitral disease during the greatest age incidence of pulmonary tuberculosis would readily explain this. In 265 autopsies Norris⁶⁹ found the mitral valve affected in 183, the aortic in 126, the tricuspid in 23, and the pulmonary in 13. Pure mitral insufficiency, according to Meisenberg,⁷⁰ is the most frequent lesion associated with pulmonary tuberculosis; more rarely aortic insufficiency occurs, and still more rarely mitral stenosis, with or without simultaneous insufficiency, and most rarely a simultaneous affection of several valves.

Mitral Insufficiency. The coincidence of the age incidence of pulmonary tuberculosis and of this lesion has already been mentioned. Some hold that for anatomical and physiological reasons this lesion more than any other is likely to occur with pulmonary tuberculosis, while it does not apparently predispose to pulmonary tuberculosis.

However this may be, mitral insufficiency is certainly the most frequent cardiac lesion in pulmonary tuberculosis. In 36 instances of "organic murmurs" at the Phipps Institute,⁷¹ pure mitral insufficiency occurred 24 times, and was present in connection with other murmurs 7 times. In 77 collected instances of valvular disease in connection with pulmonary tuberculosis, I found pure mitral insufficiency in 44, and in 4 others it was associated with other lesions. In Norris⁷² report on 293 valvular lesions, mitral insufficiency was found 84 times alone, and in conjunction with other lesions 13 times.

It seems, if well compensated, to exert little influence upon the course or the symptoms of the pulmonary tuberculosis, but Anders⁷³ has noted more and more profuse hemoptysis, increased dyspnoea of a cardiac type, and lower temperature. I have not noted in my few cases such symptoms. When compensation is broken, however, the pulmonary tuberculosis may quickly advance. In the Leipzig

⁶⁸ Loc. cit.

⁷⁰ Loc. cit.

⁷² Loc. cit.

⁶⁹ Loc. cit.

⁷¹ Third Annual Report, Phila., 1907, p. 40.

⁷³ Loc. cit.

figures, pulmonary tuberculosis occurred in 16 per cent. of all cases of mitral insufficiency. Among the 7 cases of valvular disease occurring in the last 1300 patients at the Adirondack Cottage Sanitarium, mitral insufficiency was present 4 times (3 in males). In 3 of these a history of inflammatory rheumatism long antedating the pulmonary tuberculosis was obtained, and in the other patient a history of indefinite "rheumatic" pain was noted for two years or longer, while the first symptom referable to the pulmonary tuberculosis was noted over four years previously. The indefinite history in regard to the rheumatism makes this case of little value in regard to this point. Of the 4 patients, 2 are dead, 1 is doing very well, while the other has such advanced disease that her activities are necessarily limited.

Mitral Stenosis. Stenosis of the mitral valve, far less frequent than insufficiency, has long been looked upon as antagonistic to pulmonary tuberculosis, that is, that pulmonary tuberculosis is more rarely associated with mitral stenosis than with other forms of heart disease. If any disease that produces cyanosis affords protection against pulmonary tuberculosis, as Rokitsansky⁷⁴ believes, then pulmonary tuberculosis should rarely be associated with mitral stenosis. This increased vascosity of the blood has been shown by Anders⁷⁵ to occur in pulmonary stenosis, which is generally complicated by pulmonary tuberculosis, and pulmonary tuberculosis is not most frequently associated with aortic regurgitation, as James⁷⁶ stated. Meisenberg⁷⁷ has attributed the relative infrequency of pulmonary tuberculosis in mitral stenosis to increased blood pressure, reduced blood stream, slowing of the blood stream, and chemical changes in the blood. Otto⁷⁸ and Peter⁷⁹ think that the congestion of the bases throws increased work upon the apices, and so better aëration prevents against tuberculosis. More recently Graham⁸⁰ has collected some interesting explanations. Congestion of the lung produces dilatation and tortuosity of the capillaries which project into the alveoli. There is also cell proliferation, with slight hypertrophy of fibrous and muscular tissue. Implantation and proliferation of tubercle bacilli are retarded because the increased flow of serum exerts an increased germicidal effect, the cells are better nourished, and the bronchioles are better flushed out; the increase of muscular tissue may better aid in forcing out foreign matter; the fibrous hyperplasia may prevent the growth of or wall off already existing foci; and the chronic congestion may exert some inhibition, since Hess⁸¹ has shown that the resistance of the lung is proportional to the amount of elastic tissue present, and Pierce⁸² that in congestion

⁷⁴ Loc. cit.

⁷⁵ Loc. cit.

⁷⁶ Quoted by De Renzi, Path., Sympt., u. Behandl. d. Lungenschw., Wien., 1894.

⁷⁷ Loc. cit.

⁷⁸ Loc. cit.

⁷⁹ Gaz. des hôp. de Paris, 1875, xlviii, 769, 785

⁸⁰ Loc. cit.

⁸¹ Beitr. z. Klin. d. Tub., 1904, ii, 103.

⁸² Proc. Path. Soc. Phila., 1901, N. S., iv, 215.

more elastic tissue is found. Anders⁸³ does not believe that the passive congestion is the true inhibiting factor, as hemoptysis relieves the symptoms, and Malmonte⁸⁴ attributes little, but Teissier⁸⁵ and Tileston much, to congestion. Tileston,⁸⁶ in a recent very suggestive article, reviews the autopsy records of the Massachusetts General Hospital, the Boston City Hospital, and the Long Island Hospital of Boston, which bear upon this point. In 128 cases of mitral stenosis he found a much lower percentage of pulmonary tuberculosis than in the material from which they were drawn. Patients with a high degree of stenosis had much less often pulmonary tuberculosis and in no instance active tuberculosis. They seemed also less liable to contract pulmonary tuberculosis, but if they did so, the disease ran a mild course with a strong tendency to cure. Tileston⁸⁷ has excluded the "rheumatic diathesis" and cardiac hypertrophy, and does not think that increased arterial pressure in the lungs is the factor of importance. The relative immunity, which he believes exists in these patients, he attributes to the passive hyperemia of the lungs consequent upon the mitral lesion. The cardiac hypertrophy is, according to Abrams,⁸⁸ the essential factor. I know of no observations upon the opsonic index in these conditions. Norris⁸⁹ figures do not indicate that mitral stenosis is overlooked clinically in connection with pulmonary tuberculosis more frequently than other forms of valvular disease, and it is difficult to accept Teissier's⁹⁰ figures, who finds some sclerosis of the mitral valve in 40 per cent. of all patients with pulmonary tuberculosis, and attributes it to a sclerogenic poison of the tubercle bacilli. In 54 instances of cardiac disease Potain found pulmonary tuberculosis in 9 (16 per cent.), and Meisenberg⁹¹ found it in 2.6 per cent. of his Leipzig cases. Patients with mitral stenosis often do remarkably well, better even than those with mitral insufficiency who often upset many prognostic data.

Three patients, two men and one woman, have been sent to the Adirondack Cottage Sanitarium with a diagnosis of mitral stenosis. In one the diagnosis had been made years previously, and the patient with advanced laryngeal and pulmonary tuberculosis did poorly, returned home, and died. One of the other two patients has done very well. The third is still at the Sanitarium. In none of them was I certain of any cardiac lesion.

A point of interest connected especially with this type of cardiac disease is the treatment of tuberculosis by passive congestion, first suggested by Bier. Its great success in the treatment of various tuberculous processes has led many to attempt to apply such pro-

⁸³ Loc. cit.

⁸⁴ Loc. cit.

⁸⁵ Des lésions de l'endocarde chez les tuberculeux, Paris, 1894.

⁸⁶ Tileston, Jour. Amer. Med. Assoc., 1908, 1, 1179.

⁸⁷ Loc. cit.

⁸⁸ Quoted by Anders, loc. cit.

⁸⁹ Loc. cit.

⁹⁰ Loc. cit.

⁹¹ Loc. cit.

cedures to the lungs. A prone position has long been advocated for various reasons, but Jacoby⁹² has attempted, by elevating the hips and legs above the thorax, to accentuate the hyperemia produced by the prone position. More recently, Kuhn⁹³ has suggested his mask covering both mouth and nose, which admits air slowly through valves which may be regulated, but permits free egress of all air. This has been widely used, but lacks as yet full confirmation.

Aortic Insufficiency. This lesion is much rarer than many older authorities stated, and occurs, according to Meisenberg⁹⁴ in 5.4 per cent., according to Norris in 3.6 per cent., of all patients with cardiac lesions in pulmonary tuberculosis, and in 0.09 per cent. of all patients with pulmonary tuberculosis. Neither inhibiting nor predisposing influences have been attributed to it. In the 1300 cases this lesion has occurred twice; one patient is at present in the Sanitarium and the other returned home with an arrested process. De Renzi⁹⁵ and others believe, however, that this type of valvular disease is the most frequent in pulmonary tuberculosis, but Anders⁹⁶ combats this view and holds that when pulmonary tuberculosis is associated with it, the lung disorder aggravates the cardiac disease.

Aortic Stenosis. This lesion, as would be supposed, is apparently much less frequent than insufficiency, judging from both the clinical and autopsy records. Its frequency clinically may be judged from the fact that Meisenberg⁹⁷ saw it twice in 4649 cases of pulmonary tuberculosis, and von Ruck⁹⁸ once in 3000. I have seen no instance of it.

Pulmonary Stenosis. Pulmonary stenosis is rare, occurring, according to Norris,⁹⁹ in 0.12 per cent. of patients with pulmonary tuberculosis, and in 4.8 per cent. of patients with pulmonary tuberculosis and cardiac disease. Of 459 cases, 37 per cent. died of pulmonary tuberculosis. On the other hand, Anders,¹⁰⁰ who has added 36 cases from the literature to the 24 collected by Lebert,¹⁰¹ thinks pulmonary tuberculosis always follows congenital pulmonary stenosis, and there is little doubt that the longer a patient lives with pulmonary stenosis the more likely he is to die of pulmonary tuberculosis. Lebert¹⁰² believes that one-sixth of the subjects, if they live to reach their twentieth year, die of pulmonary tuberculosis, while Stolker¹⁰³ holds one-seventh. Vierordt¹⁰⁴ held that tuberculosis was no more frequent in patients with pulmonary stenosis than in those with any other congenital heart disease, due to their lack of vitality and resistance, and Otto¹⁰⁵ states that tuberculosis is the rule in all

⁹² Münch. med. Woch., 1899, xlv, 628, 659.

⁹³ Münch. med. Woch., 1907, liv, 782.

⁹⁵ Path., Sympt., u. Behandl. d. Lungenschw., Wien, 1894, p. 195.

⁹⁶ Loc. cit.

⁹⁸ Personal communication to Norris, loc. cit.

¹⁰⁰ Loc. cit.

¹⁰² Loc. cit.

¹⁰⁴ Nothnagel, Spec. Path. u. Therap., 1901, xv, 100.

⁹⁴ Loc. cit.

⁹⁷ Loc. cit.

⁹⁹ Loc. cit.

¹⁰¹ Berl. klin. Woch., 1867, p. 233.

¹⁰³ Quoted by Norris, loc. cit.

¹⁰⁵ Loc. cit.

lesions of the right side. According to Lebert,¹⁰⁶ while 30 per cent. of these patients die of tuberculosis, it is not necessarily of the lungs, and when in the lungs the cause is not to be attributed to anemia, but to the unequal and abnormal character of the circulation. The lungs receive their blood supply, as Norris¹⁰⁷ points out, from the bronchial arteries. The pulmonary tuberculosis is usually miliary in type (Fox¹⁰⁸).

Frommolt¹⁰⁹ states that disease of several valves is not uncommon in connection with this lesion, but otherwise seldom occurs. Meisenberg¹¹⁰ found only 20 in 182 instances of cardiac disease in pulmonary tuberculosis, in which the aortic and mitral valves were simultaneously affected. Jaccoud has observed many instances of tricuspid insufficiency with venous pulse, and Osler¹¹¹ mentions the frequency with which the venous pulse is observed in pulmonary tuberculosis. Other observers have made little or no note of it. Tricuspid insufficiency may be a source of great danger in benign chronic cases with sclerosis.

To summarize, it may be said that pulmonary stenosis is always the primary disease, mitral insufficiency and aortic insufficiency usually the primary. The most frequent cardiac lesion secondary to pulmonary tuberculosis in patients up and about is mitral stenosis. Pulmonary tuberculosis occurs more frequently in patients with pulmonary stenosis than in any other form of cardiac disease. Mitral insufficiency is associated with pulmonary tuberculosis more often than any other form of valvular disease, but aortic insufficiency is not very much less frequent. Aortic stenosis is very rarely associated with pulmonary tuberculosis, and pulmonary stenosis is infrequent in pulmonary tuberculosis. Involvement of several valves simultaneously is rare in these cases.

DIAGNOSIS. The heart plays an important part in the diagnosis of pulmonary tuberculosis, and in many instances it is impossible to arrive at any definite conclusion. Marshall¹¹² reports several instances at the Johns Hopkins Hospital in which cardiac disease was diagnosed as pulmonary tuberculosis and the error discovered at autopsy. Three instances have come under my notice in which a similar diagnosis was made and in which, after a most careful study, pulmonary tuberculosis could be excluded.

TREATMENT. The treatment of the various forms of valvular heart disease, occurring in connection with pulmonary tuberculosis, differs in no way from that ordinarily employed in cardiac disease. Moderate elevations, not over 2000 feet, are said by Anders¹¹³ to be the best for patients with valvular disease, but if well compensated

¹⁰⁶ Loc. cit.

¹⁰⁸ Diseases of the Lungs and Pleura, London, 1891, p. 547.

¹¹⁰ Loc. cit.

¹¹¹ Principles and Practice of Medicine, 1905, p. 333.

¹¹³ Loc. cit.

¹⁰⁷ Loc. cit.

¹⁰⁹ Loc. cit.

¹¹² Loc. cit.

they often do well at greater elevations. Patients should be fully warned against overexertion, for they have even less reserve force than the ordinary patients with only cardiac disease, and slight efforts may produce signs of non-compensation in both systems, rendering them much more susceptible to secondary infection (Bohland¹¹⁴). The treatment of the rapid heart action and cardiac weakness in pulmonary tuberculosis differs but slightly from that ordinarily employed. Digitalis and strophanthus are of little avail. Arsenic, strychnine (in large doses), an ice-bag over the precordium, carbonic acid baths, rubs, absolute rest at first, and carefully regulated exercises relegated chiefly to those muscles which throw little or no stress upon the muscles of the thorax, are all of value. Nitroglycerin may give marked relief. Excitement of any sort should be avoided, and it is wise to refrain from the use of alcohol and tobacco and to use coffee in moderation, if at all. Burton-Fanning¹¹⁵ has pointed out the value of restriction of food, and in some cases it is wise to omit milk for a time. Flatulency must be rigorously combated and the diet should be rich in easily digested proteids. Palpitation of the heart should be treated by rest and the ice-bag, but bromides and valerian may be required.

BACILLUS COLI COMMUNIS: THE CAUSE OF AN INFECTION CLINICALLY IDENTICAL WITH TYPHOID FEVER.

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CASES of infection clinically identical with typhoid fever have been caused by *Bacillus faecalis alcaligenes*, the paratyphoid and paracolon bacilli (*Bacillus paratyphosus*, types A and B), *Bacillus enteritidis*, and *Bacillus psittacosis*. The close biological relationship of these members of the typhoid-colon group (the Typhaceæ, as Loeffler has designated them recently) and the fact that the paracolons are more nearly related to *Bacillus coli* than to *Bacillus typhosus* naturally lead to the suspicion that some strains of *Bacillus coli* also might be capable of causing the typhoid symptom complex. Though there is increasing evidence of variability, and even mutation, of

¹¹⁴ Handb. d. chron. Lungenschw., 1904, p. 694.

¹¹⁵ Open-air Treatment of Pulmonary Tuberculosis, Chicago, 1905, p. 103.

type among the Typhaceæ, a discussion of this phase of the typhoid problem does not come properly within the scope of our paper.

Our attention was first directed to the question of systemic infection by the colon bacillus pursuing a typhoid-like course in 1903, when Buxton and one of us recovered colon bacilli from the blood of two cases in Bellevue Hospital which were considered clinically as examples of mild typhoid fever. These cases were reported briefly on a former occasion:

CASE I.—A. F., butcher's helper, entered Bellevue Hospital in the service of Dr. Thompson, August 15, 1903, the eighth day of his illness. He had been swimming daily in the East River. For a week he had suffered from general weakness, frontal headache, pain in the stomach and legs, bad taste in the mouth, and loss of appetite, but in spite of these symptoms had continued at work washing beef tongues in a damp cellar. There had been no vomiting or diarrhoea.

On admission the patient's tongue was coated and tremulous. The spleen was not palpable. About two dozen rose spots were found upon the chest and abdomen. The general appearance of the patient suggested mild typhoid fever. Fresh rose spots appeared on August 17, but by the 20th all the spots had disappeared. The temperature on admission was 100.4° F; pulse, 96. Thereafter the temperature gradually fell and reached normal on the twelfth day of the disease. The patient's serum was tested against the typhoid bacillus on the tenth and twelfth days, microscopically in dilution of 1 to 100, both times with negative results after two hours. Unfortunately the reaction of the serum against the colon bacillus was not tested. On the tenth day of the disease 10 c.c. of blood, taken from a vein at the elbow, contained a colon bacillus in pure culture. August 30, after twelve days of normal temperature, a relapse occurred. During the relapse the temperature rose to a maximum of 101° F. The duration of the relapse is unknown, since on September 14, thirty-eight days after admission, the patient insisted on leaving the hospital with a pulse of 120 and a temperature of 99.5° F.

CASE II.—B. McM. Occupation, housework. Entered Bellevue Hospital August 14, 1903, in the service of Dr. Thompson, complaining of severe general headache, dry cough, pain in the back and sides, loss of appetite, and constipation. She had a temperature of 101.4° F. and a pulse of 100. A clinical diagnosis of mild typhoid fever was made. On the sixth day of illness her serum, in dilution of 1 to 100, was negative microscopically to the typhoid bacillus after two hours. Two days later her blood was found to contain a colon bacillus in pure culture. But the following day her serum gave a positive Widal reaction at 1 to 100. The reaction against *Bacillus coli* was not tested.

According to present standards, the data concerning Case II

are too meager to permit our drawing any conclusion regarding it. We are unable to determine whether the case should be considered as one of primary systemic infection with a colon bacillus, exhibiting a group reaction against the typhoid bacillus, or whether to look upon the presence of *Bacillus coli* in the blood as a secondary invasion. The former seems the more likely when one considers the small number of patients whose blood has contained *Bacillus coli communis* during life, and the very infrequent association of *Bacillus typhosus* and *Bacillus coli* in the blood of typhoid cases.

Case I, on the other hand, meets the requirements more fully; that is, (1) it was clinically mild typhoid fever, (2) *Bacillus coli communis* was obtained in pure culture from the blood, and (3) the serum reaction was negative to the typhoid bacillus as late as the last day of the fever in the primary attack. It would have added to the completeness of the data if the patient's serum had been tested against several strains of *Bacillus coli*, but this was not done. With these cases in our possession, a search of the literature for similar ones was undertaken.

In 1902 Fox recovered a colon bacillus from the blood of a case which resembled typhoid fever clinically. The serum of the patient gave a positive Widal reaction on the thirty-second day of the disease, though it had previously been negative. Therefore, as in Case II above, the true nature of the infection was doubtful.

In the same year Burch wrote, under the title of "Colon *Bacillus* Infection," that for ten years he had seen in his practice cases of fever, lasting from seven to ten days, which were ushered in by malaise, a gradual rise of temperature to a maximum of 103° to 104° F. by the third or fourth day, diarrhoea, or, less frequently, constipation. The tongue was dry and often coated. Sometimes there was mild delirium; there was always more or less headache. Tympanites occurred in some cases. The whole clinical picture was that of typhoid fever. The leukocytes were diminished in all cases. The urine was always acid and many times swarmed with motile organisms resembling *Bacillus typhosus*. The diazo reaction was, as a rule, well marked. The Widal reaction, made daily (dilution approximately 1 to 5), was absent in every case throughout its course, but the serum reacted promptly to the organism obtained under aseptic conditions from the bladders of the patients. This organism responded to all the cultural tests for *Bacillus coli communis*. This remarkable series of cases was observed in Baldwinsville, New York. While the nature of the infection cannot be accepted as proved, the cases appear to have been what the author considered them, examples of colon bacillus infection pursuing the course of typhoid fever.

In 1903 three papers appeared upon this subject. Evans and Sailer reported the case of a negro who, on February 12, suddenly became weak and dizzy. Next day he had diarrhoea, loss of appe-

tite, and gastric disturbances. The spleen was palpable. Rose spots were present. The disease ran the course of typical typhoid fever. The temperature became normal on March 6. A relapse occurred which lasted to the 16th. The leukocytes on February 15 numbered 5900; February 17, 10,480; March 9, 7000. The diazo reaction was positive in the first part of the illness. The serum tests upon which the diagnosis rests must be given in detail: Against *Bacillus typhosus* the reaction was positive at 1 to 10 on five occasions, while it was negative at higher dilutions. Against *Bacillus paratyphosus* (four strains), the reaction was incomplete at 1 to 10 on the twentieth day of the disease, but it was positive at 1 to 10 on the forty-third day of the disease. Against *Bacillus coli communis* (Pasteur Institute culture), the reaction was complete in forty-five minutes at 1 to 100 on the twentieth day. On the forty-third day, the reaction was complete at 1 to 150 in one hour, partial at 1 to 200 and 250 in one and a half hours (no increase later), and negative at 1 to 300 and 1 to 400 after twenty-four hours. The case, therefore, appears to have been caused by a colon bacillus.

A. Jacoby, of New Orleans, reported a case which he considered especially interesting because it resembled typhoid fever so closely: A laborer, aged fifty years, was working on a railroad in Texas when he was taken ill. He had drunk any water he could get. There had been no diarrhoea. The temperature on admission to hospital was 101° F.; pulse rapid. The abdomen was distended. The spleen was much enlarged. Rose spots were present. No malarial organisms found. The Widal reaction was negative four times (dilutions and days not stated). Rose spots and the urine were examined for *Bacillus typhosus* with negative results. *Bacillus coli communis* was present in the urine in large numbers. After admission the temperature did not rise above 102° F., and in a week began to decline. On the sixteenth day, however, double lobar pneumonia developed, the temperature rose suddenly to 104° F., and death followed. At autopsy, the small intestine was congested throughout its extent, but Peyer's patches were not involved.

Bauermeister reported the case of a man, aged thirty-five years, from whose blood he obtained *Bacillus coli communis* in pure culture on several occasions; he regarded the case clinically as typhoid-like in its course. Similar attacks recurred over a period of one and one-half years, when one of the patient's testicles had to be amputated because of an abscess which contained *Bacillus typhosus*. Bauermeister suggests that the original colon bacillus had changed its biological characters probably as the result of long residence in the body. This case seems to us to belong with the colon bacillus septicemias rather than in the typhoid group which we are discussing.

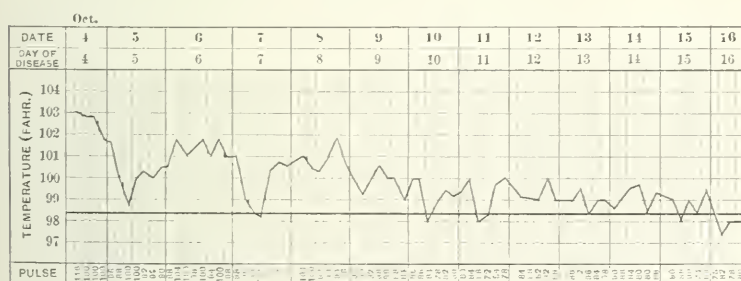
In 1904 Widal and Lemièrre reported two cases, which they state resembled typhoid fever, and from whose blood they recovered colon

bacilli. As their second case showed multiple abscesses of the kidney at autopsy, it cannot be included in the present series. Their third case occurred in a man, aged thirty-five years, who was taken ill suddenly five days before admission to the hospital with violent abdominal pain, repeated chills, and vomiting. He had almost constant headache and complete insomnia after the onset. There was no epistaxis or diarrhoea. The temperature on admission was 103.5° F.; pulse 90. There was marked abdominal distention. No rose spots. Spleen voluminous. Violent intestinal peristalsis. Heart, lungs, and liver normal. The abdominal pain and tenderness disappeared. Diazo reaction negative. Serum, negative to the typhoid bacillus. The patient's illness lasted from December 12 to December 21. He was discharged from the hospital December 24. On December 18 a colon bacillus was obtained in pure culture from 3 c.c. of blood. December 24, the patient's serum agglutinated his own bacillus at 1 to 30.

These are the only cases we have been able to find, reported as cases of systemic infection by the colon bacillus, pursuing the course of typhoid fever, which will bear analysis.

In the fall of 1905 we were fortunate enough to have the privilege of studying the following case:

CASE III.—G. K., aged twenty-nine years, entered Bellevue Hospital October 4, in the service of the late Dr. Loomis. He had been in Central America for a year and a half, where he contracted malaria and yellow fevers. Early in July he spent eight days in Jamaica, *en route* to New York, where he has remained since August 24. During this time he has been well. The present illness dates from September 30, when he felt feverish. He waked



Temperature chart of Case III (G. K.).

next morning with a headache, mainly frontal and occipital; pain in the muscles of the neck on moving the head, and pain in the right knee and arm. Walking was difficult. In spite of these symptoms, the patient went to his office, where he remained until afternoon. On the way home he felt very weak. When he got into bed, he had a chill, lasting twenty minutes, followed by sweating. The headache

continued, and pains developed in the back. Three days after the first chill he had another (October 3) lasting ten minutes. His head and hands became very hot, but he did not sweat. October 4 he felt so weak that he decided to remain in bed. His bowels had not moved since October 1. For several days he had had a dry, hacking cough. In the afternoon, when he entered the hospital, he was chilly and suffered from nausea and vomiting.

Physical Examination. The patient is a well-nourished, well-developed man. Face flushed, skin dry, but in good condition. Tongue large, flabby, coated, and tremulous. Heart and lungs normal. Arteries not thickened. Slight abdominal distention. Slight tenderness in left upper quadrant of abdomen. Liver normal. Spleen not palpable. A few rose spots on the abdomen. The clinical picture is that of mild typhoid fever.

Subsequent History. October 5, headache and abdominal pain all night. Slept about two hours. Fresh crop of rose spots. The spots continued to appear at intervals until the 16th. Slight bleeding when the patient blew his nose. From the 6th to the 9th the patient complained chiefly of vague abdominal pain and headache.

October 9. Conjunctivæ and skin slightly icteric.

October 10. Pain in right hypochondrium (heretofore the pain was not localized). Marked jaundice. Tenderness over gall-bladder. Spleen percusses large, but cannot be felt.

October 11. Jaundice deeper. Tenderness over gall-bladder more marked. Nausea. Severe frontal headache.

October 12. Gall-bladder exquisitely tender. Spasm of overlying muscles. Patient brighter.

October 14. Gall-bladder palpable. Extends one and three-fourth inches below free border of ribs.

October 16. Gall-bladder less tender. Jaundice beginning to clear up.

Thereafter the jaundice gradually disappeared, the gall-bladder receded, and tenderness was developed only on deep pressure. This tenderness persisted, however, until October 27, and for months afterward the patient had a sense of discomfort on bending over. The patient was discharged from the hospital as cured on November 17.

Cytological Examinations of the Blood. October 4. Leukocytes, 5000; polynuclears, 62 per cent.; lymphocytes, 24 per cent.; large mononuclears, 8 per cent.; transitionals, 4 per cent. No malarial organisms.

October 5. Leukocytes, 6000; polynuclears, 77 per cent.; lymphocytes, 14 per cent.; large mononuclears, 8 per cent.; eosinophiles, 1 per cent.

October 9. Leukocytes, 6400; polynuclears, 45 per cent.; lymphocytes, 29 per cent.; large mononuclears, 6 per cent.; transi-

tionals, 18 per cent.; eosinophiles, 5 per cent.; mast cells, 0.3 per cent.

October 10. Leukocytes, 8000; polynuclears, 66 per cent.; lymphocytes, 20 per cent.; large mononuclears, 10 per cent.; transitionals, 2 per cent.; eosinophiles, 4 per cent.

Two blood cultures in broth were made October 5 and 9, but both proved negative (Buxton).

Three rose spots were examined bacteriologically with negative results (Buxton).

The urine was examined bacteriologically twice and found negative (Buxton, Warren).

The feces were examined three times for *Bacillus typhosus* or any of the intermediates, and also found negative (Norris, Buxton).

AGGLUTINATION REACTIONS.¹ AGAINST *BACILLUS TYPHOSUS*.

October 9, 10, 13, 14, 16, 18, 19:

Microscopically, in dilution of 1 to 50, negative after two hours.

Macroscopically, in dilution of 1 to 100, negative after twenty-four hours.

October 21:

Microscopically, in dilution of 1 to 50, negative after two hours.

Macroscopically, in dilution of 1 to 100, negative after twenty hours.

Macroscopically, in dilution of 1 to 200, negative after twenty hours.

October 23:

Microscopically, in dilution of 1 to 50, negative after two hours.

Macroscopically, in dilution of 1 to 100, negative after twenty hours.

Macroscopically, in dilution of 1 to 200, negative after twenty hours.

Macroscopically, in dilution of 1 to 400, negative after twenty hours.

October 24:

Microscopically, in dilution of 1 to 50, negative after two hours.

Macroscopically, in dilution of 1 to 200, negative after twenty hours.

Macroscopically, in dilution of 1 to 20, negative after twenty hours.

AGAINST *BACILLUS PARATYPHOSUS* (TYPES A AND B).

October 14:

Macroscopically, in dilution of 1 to 10, positive after twenty hours.

October 18 and 19:

Macroscopically, in dilution of 1 to 100, negative after twenty hours.

October 21:

Macroscopically, in dilution of 1 to 100, negative after twenty hours.

Macroscopically, in dilution of 1 to 200, negative after twenty hours.

October 23:

Macroscopically, in dilution of 1 to 100, negative after twenty hours.

October 24:

Macroscopically, in dilution of 1 to 200, negative after twenty hours.

Macroscopically, in dilution of 1 to 20, negative after twenty hours.

¹ The dilutions stated are dilutions of the serum before admixture with the suspensions of bacilli—the final dilutions, therefore, would be twice as high.

AGAINST BACILLUS COLI (STRAIN A).

October 14:

Macroscopically, in dilution of 1 to 20, positive after twenty hours.

October 18 and 19:

Macroscopically, in dilution of 1 to 100, positive after twenty hours.

October 21:

Macroscopically, in dilution of 1 to 200, positive after twenty hours.

October 23:

Macroscopically, in dilution of 1 to 400, positive after twenty hours.

October 24, 26, and 28:

Macroscopically, in dilution of 1 to 200, positive after twenty hours.

October 30 (strains A and B):

Macroscopically, in dilution of 1 to 200, positive to A after twenty hours
negative to B after twenty hours.

November 1:

Macroscopically, in dilution of 1 to 100, positive to A after twenty hours.
negative to B after twenty hours.

November 15, the serum in dilution of 1 to 100 was tested against seventeen strains of *Bacillus coli*, including strains A and B previously used.

The reactions were positive with strains 2, 6, 13, and A.

December 29, the serum no longer agglutinated any strain of *Bacillus coli* in dilutions of 1 to 100 and 1 to 20.

All of the reactions above noted were end-reactions—tests with more dilute serum proving negative.

While we are aware that we have not proved *beyond doubt* (through our failure to recover the colon bacillus from the blood) whether G. K.'s infection, was local (that is, a colon bacillus cholecystitis) or general, we are convinced that we have proved that the disease was not caused by *Bacillus typhosus* or any of the intermediates. The case was considered clinically to be mild typhoid fever by all who saw him, including the late Dr. Loomis and Dr. Thompson. Nevertheless, to forestall criticism, it will be well to discuss the clinical differential diagnosis.

The various clinical possibilities seem to have been: (1) Clinical typhoid fever, complicated by cholecystitis. (2) Primary cholecystitis. (3) Tuberculosis. (4) Sepsis. (5) Pyelitis.

The condition of the urine throughout the disease excludes pyelitis.

The course of the disease and the subsequent history exclude sepsis and tuberculosis (the patient was not lost sight of until the fall of 1907).

There remain only the two varieties of cholecystitis, catarrhal and suppurative. Suppurative cholecystitis may be excluded for the same reasons as sepsis. As against a primary catarrhal cholecystitis caused by the colon bacillus, we base the clinical diagnosis of a typhoid-like fever upon the following facts: mode of onset with the gradually developing malaise, initial chills, slight bronchitis, slight epistaxis(?), persistent headache, appearance of rose spots on the fifth day of the disease, the course of the disease, the emaciation, and the phenomena of convalescence. Leukopenia, with a low polymuclear count, was present until the day after the cholecystitis

became evident clinically. The leukocytes then rose to 8000 and the polynuclears from 45 per cent. to 66 per cent. Though there had been previously vague abdominal pains, these are not uncommon in typhoid fever. Definite tenderness over the gall-bladder did not develop until the day following the subicteric tinging of the conjunctivæ and skin. We are very positive in this statement, because for years it has been our habit to examine daily the gall-bladder region of all patients in the wards suffering from typhoid fever. From all of these considerations we feel justified in thinking that the case of G. K. was clinically typhoid fever, complicated by cholecystitis.

In order to make this study as complete as possible, we have sought during the last three years to obtain the serum of cases suffering from a colon bacillus cholecystitis for the study of its agglutination reactions, but unsuccessfully. We have also written to prominent surgeons to obtain such data, but none of them could furnish the desired information. The literature is silent upon this point. The development of immune bodies for various strains of *Bacillus coli* in cases of cholecystitis caused by this bacillus offers an interesting and important field for study.

Though it is well established that *Bacillus coli* may enter the blood during life, only a limited number of cases have been reported in which this fact has been demonstrated by blood culture. Most recent writers on localized colon bacillus infections, for example, of the gall-bladder and of the kidney and its pelvis, recognize the systemic blood stream as one of the channels of infection (Lenhartz, Lockwood, Brewer). While in most of these cases it is probable that the bacillus is only transiently in the blood, Lenhartz and Schmeideman have reported cases in which the bacillus has been obtained by blood culture.

A limited number of cases of colon bacillus septicemia have been reported (Bertelsmann and Mann, Lenhartz, Sittman and Barlow, Albarran, Libman, De Gennes and Hartmann, Hitschmann and Michel, Stern, Stadelmann and Wolff-Eisner, Fehling, Blackader and Gillies).

With the possibility of the entrance of the colon bacillus into the blood during life proved, it seems to us that it need excite no surprise that some strains of this bacillus in view of their close resemblance to some of the paracolons, may cause under certain conditions a disease clinically identical with typhoid fever. Buxton and one of us have suggested that even *Bacillus typhosus* is incapable of causing typhoid fever unless it develops in the general lymphatic system, including the spleen and bone-marrow, and thence invades the blood, where it is destroyed in large numbers. Localized infections with *Bacillus typhosus* do not cause typhoid fever. Lentz thinks that the same conditions of infection obtain in the typhoid-like types of paratyphoid infection. While there is no direct evidence to offer,

from analogy it is probable that when a colon bacillus causes the symptoms of typhoid fever, the distribution of the bacillus in the body is the same as in the case of typhoid and paratyphoid infections.

DISCUSSION OF THE AGGLUTINATION REACTIONS FOR BACILLUS COLI. The blood examinations in Cases I and II of the Bellevue Hospital series have been noted in the clinical report. The presence of *Bacillus coli* in blood taken from a vein leaves no doubt as to the bacteremia, and we feel inclined to accept this as evidence that this bacillus was the cause of the infection. No tests for immune bodies (agglutinins) were carried out.

In Case III, G. K., blood taken from a vein on two occasions proved sterile, and the supposition that *Bacillus coli communis* was the cause of the infection is based upon the facts that immune bodies (agglutinins) for a certain strain of *Bacillus coli* were found in the blood during the febrile period and were not found after recovery, and that the same strain of *Bacillus coli* was not agglutinated by many other sera in high dilution, thus fulfilling our own ideas of the diagnostic value of agglutination reactions and coinciding with the results of Klieneberger.

	Oct. 10, 1905, 1-50 to 1-100.	Oct. 12, 1-100.	Oct. 14, 1-100.	Oct. 21, 1-200.	Oct. 23, 1-400.	Oct. 24, 1-400.	Oct. 26, 1-100.	Oct. 28, 1-200.	Oct. 30, 1-200.	Nov. 1, 1-100.	Nov. 15, 1-100.	Dec. 29, 1-100 to 1-200.
<i>Bacillus typhosus</i> .	—	—	—	—	—	—	—	—
<i>Bacillus paratyphosus</i> A and B.	—	—	—	—
<i>Bac. coli</i> A.	++	++++	++++	++++	++++	++++	++++	++++	+	—
<i>Bac. coli</i> B.	—	—	—	—	—	—
<i>Bac. coli</i> No. 2, No. 6, No. 13.	+	+
<i>Bacillus coli</i> , 12 strains.	—	—

Dilutions refer to the diluted serum; final mixtures were twice the serum diluted.

Agglutination tests in Case III gave the following results: October 10 and 12, tests against *Bacillus typhosus* were negative in dilutions 1 to 50 and 1 to 100. October 14, the serum diluted 1 to 100 was tested against *Bacillus typhosus*, *Bacillus paratyphosus* (A and B), and one strain (A) of *Bacillus coli*, and the reaction for strain A *Bacillus coli* was positive; for the other organisms, negative.

Control tests were carried out with strains of *Bacillus typhosus*, *Bacillus paratyphosus*, and certain negatively reacting *Bacillus coli* strains, and the reactions noted were end-reactions—tests with more highly diluted serum proving negative.

The macroscopic method, with fresh emulsions prepared after Borden's method, was used, and also fresh suspensions in 0.8 per cent. sodium chloride solution. October 21, the serum diluted 1 to 200 gave the same positive reaction against strain A *Bacillus coli*. October 23, the serum diluted 1 to 400 was positive for A. October 24, 26, and 28, serum diluted 1 to 200 was positive.

October 30 the serum was tested against strains A and B *Bacillus coli* and proved positive to strain A and negative to strain B, in dilution 1 to 200. November 1, the same reactions as on October 30 were obtained in dilutions of 1 to 100.

November 15, the serum diluted 1 to 100 was tested against 17 strains of *Bacillus coli*, including strains of A and B used previously.

The reactions were positive with strains 2, 6, 13, and A. December 29, the serum no longer agglutinated any of the *Bacillus coli* strains in dilutions of 1 to 100 and 1 to 20.

Bacillus coli strain A which constantly agglutinated with the serum diluted 1 to 100 from October 14 to November 15, and 1 to 400 October 23, had been obtained from one of the Bellevue cases above cited (1903). Strains 2, 6, and 13, which the serum, diluted 1 to 100, agglutinated November 15, had been obtained from the blood and the stool of a case of colon bacillus septicemia. Strain 6 was obtained from the ureter of a case of pyelitis. Therefore the serum of G. K. agglutinated 4 strains of *Bacillus coli* obtained from three different individuals.

For the various strains of *Bacillus coli* and *Bacillus paratyphosus* we were indebted to the laboratories of Drs. Buxton and Elser.

In connection with the study of Case III we have made numerous tests of the serum reactions of non-icteric and icteric cases.

NON-ICTERIC CASES. During the typhoid seasons of 1905, 1906, and 1907, 100 serum tests on 54 cases were carried out against *Bacillus coli* (strains A, B, and 2) and *Bacillus paratyphosus* (strains A and B).

The serum of a normal individual, used as a control, and the sera from 52 febrile cases, many of them *Bacillus typhosus* infections, were found negative to *Bacillus coli* (strain A) in dilutions above 1 to 20, with one exception. The serum from one febrile case, diluted 1 to 20, agglutinated *Bacillus coli* (strain A), and the serum from two cases, diluted 1 to 20, agglutinated *Bacillus paratyphosus* strains, but did not agglutinate *Bacillus typhosus* or *Bacillus coli* strains.

The sera from 31 cases did not agglutinate any one of several strains of the typhoid-colon group.

The sera from 16 cases agglutinated *Bacillus typhosus*, but not *Bacillus paratyphosus* and *Bacillus coli* strains.

Unfortunately, in 40 cases single tests only were made: In 6 cases two tests; in 3 cases three tests; in 1 case four tests; in 1 case six tests; in 2 cases nine tests; in 1 case ten tests; in the cases with six, nine,

and ten tests the blood was taken at intervals extending over an entire month.

CASES WITH JAUNDICE AS A SYMPTOM. The sera of 13 cases with well-marked jaundice as a symptom were tested against strains of *Bacillus typhosus* and *Bacillus coli*—single observations in 12 cases and three observations in 1 case. In one instance, a single observation, *Bacillus typhosus* was promptly agglutinated both microscopically and macroscopically; in a second instance, *Bacillus coli* (strain B from a pleural exudate) was agglutinated macroscopically in dilution of 1 to 100, but not above; in a third instance, a case of catarrhal jaundice, *Bacillus coli* (strain 2) was agglutinated with serum diluted as high as 1 to 100.

Thus, none of these cases, with or without jaundice, agglutinated any one of the typhoid-colon group which were tested in dilutions above 1 to 100. In view of the fact that the sera from three jaundice cases were not tested over a period of weeks, we do not intend to discuss these single positive reactions as evidence that a particular strain of *Bacillus coli* was the infecting agent, although Kelly's paper suggests that such reactions may be of value in this direction.

For *Bacillus typhosus* it is well known experimentally that the sera of immunized animals must be diluted to the thousands before selective reactions are obtained, while in clinical medicine dilutions of the patients' sera 1 to 50 give diagnostic reactions within certain time limits.

In discussing the agglutination tests for the purpose of diagnosing a colon bacillus infection, the following types of cases must be considered from theoretical and practical standpoints:

A. Cases of undoubted colon-group infection, in which blood cultures were positive during life and not during the pre-lethal stage or post-mortem. These cases may be divided into two groups:

1 (a) Cases which were typhoid-like in course, whose blood contained agglutinins for strains of the colon bacillus.

(b) Cases which were typhoid-like, whose blood did not contain agglutinins for strains of *Bacillus coli*.

2 (a) Cases which were not typhoid-like in course, whose blood contained agglutinins for strains of *Bacillus coli*.

(b) Cases which were not typhoid-like in course, whose blood did not contain agglutinins for strains of *Bacillus coli*. Endocarditis and pyelitis are examples of the last two groups.

B. Cases of supposed colon-group infection, with negative blood cultures. These cases likewise may be divided into two groups:

1. Cases which were typhoid-like in course, whose blood contained agglutinins for strains of *Bacillus coli*.

2. Cases which were not typhoid-like in course, whose blood contained agglutinins for strains of *Bacillus coli*. Cholecystitis and pyelitis are examples of this last group.

In the light of our knowledge of group-agglutinins, one must con-

sider the relation of other typhoid-colon group infections to infections by the colon bacillus; for example:

1. Cases of undoubted *Bacillus typhosus* infection, clinically typhoid-like in nature, in which blood cultures and agglutination tests for *Bacillus typhosus* were positive and agglutinins for colon strains were found.

2. Cases in which agglutinins were positive for *Bacillus typhosus* alone, with blood cultures positive for *Bacillus coli*; or in which blood cultures were negative, and yet agglutinins were found for both typhoid and coli strains.

3. Cases in which blood cultures were positive for *Bacillus paratyphosus* and agglutinins were found for paratyphoid and colon strains.

4. Cases in which blood cultures were positive for *Bacillus coli* and whose serum agglutinated typhoid or paratyphoid strains.

Finally, the agglutination of colon strains by normal sera must be considered. The results of Klieneberger show a high agglutinin content for normal serum, diluted 1 to 2000 to 3000, for certain colon strains, and would lead one to consider the possibility that some individuals are producers of antibodies for *Bacillus coli*. Our results are at variance with Klieneberger's in that normal serum and sera from febrile cases have not caused agglutination of colon strains excepting in dilution of 1 to 20 in a febrile case without jaundice, and in dilution of 1 to 100 in two cases with jaundice. This contradiction is readily explained by the fact that in testing 17 different strains of *Bacillus coli* we found 4 strains only which were agglutinated by 5 out of 67 sera.

The fact that Klieneberger worked with a strain which was agglutinated by many normal sera would not invalidate our results unless it were proved that his colon strain is identical with one or more of those used by us.

Terminal colon bacillus infections and the reactions of typhoid bacillus carriers do not concern us.

Articles in the literature dealing with agglutination tests in *Bacillus coli* infections are not numerous, yet one or two of them, together with the results obtained in Case III cover the theoretical and practical considerations in respect to diagnostic reactions.

Klieneberger refers to Pfaundler's statement that the colon bacillus is agglutinated when one mixes together the serum and a strain of *Bacillus coli* obtained from the same patient, and not when the serum and bacteria are obtained from different individuals under normal conditions. From the work of Wassermann and others it is known that immune coli sera differ not only in respect to the strain used for immunizing, but also according to the type of animal used for immunization, and to explain these differences extensive variation in receptors of different coli strains are supposed to exist. Noting these statements, Klieneberger worked with sera from

normal adults, and then from the newborn, with immune coli sera from immunized animals and from a man infected with *Bacillus coli*. The standard strain of *Bacillus coli* used was from the urine of a patient with a genito-urinary colon bacillus infection. Thirteen other strains of *Bacillus coli* were selected from 21 strains, for carrying out absorption experiments on sera agglutinating the standard strain. From six newborn infants, the sera being tested against 6 coli strains, 2 sera agglutinated 2 different strains, one each as high as 1 to 160; and the agglutination from 1 strain only was proved by absorption tests. From normal adults with no history of icterus or typhoid fever, 2 sera, diluted 1 to 1280, agglutinated 2 strains of *Bacillus coli*; 4 cases, 1 to 320, agglutinated 3 strains; 1 case, 1 to 640, agglutinated 1 strain. It is noticeable that 2 strains were agglutinated by 5 sera diluted 1 to 320 or over, and that each serum, 1 to 320, agglutinated at least 1 strain. Three strains were not agglutinated by any serum, and 5 strains were not agglutinated by any serum diluted above 1 to 80. No serum agglutinated *Bacillus typhosus* or *Bacillus paratyphosus* (A and B) above 1 to 20. One normal serum (M) agglutinated weakly 2 strains, with serum dilutions of 1 to 2560; 1 strain, with serum dilutions 1 to 640; 1 strain, 1 to 320; 1 strain, 1 to 160; and 3 strains not above 1 to 40. With normal serum M, by precipitation with 8 strains, partial agglutinins were found for 5 colon strains, and with normal serum R, partial agglutinins for 4 colon strains were found; and, further, it was found that one could group the agglutinable strains under two subdivisions, one of which was agglutinated constantly by highly diluted sera and the other irregularly and by low dilution. A second group of coli strains was not agglutinated by any serum. From these observations Klieneberger concludes that a tested strain of *Bacillus coli* has set up a specific immunity only when we can show that it is agglutinated with abnormally high dilutions, or that normal serum does not agglutinate the strain. He also speaks of an increment in agglutinating power as indicative of immunization from active infection, and cites 2 cases as showing this fact; and he refers to observations on *Bacillus coli* infections of the urinary tract, during which he had noted the same incremental auto-immunization.

In opposition to Pfaundler, the first fact noted was that in many *Bacillus coli* infections an agglutinating effect for the causative strain was absolutely wanting. He obtained a "group" agglutination for the typhoid bacillus four times, and for the paratyphoid bacillus once, with the *Bacillus coli* serum. Klieneberger concludes that in cases of *Bacillus coli* infection in man, when the causative agent has not been isolated, it is scarcely possible to prove a *Bacillus coli* infection with serum tests unless immunity to *Bacillus coli* can be determined, when an increasing agglutination and abnormally high agglutination is found, and normal controls are negative. Further, Klieneberger immunized rabbits against 5 active strains

of *Bacillus coli* with 1 c.c. of a formalized broth culture injected intravenously and obtained a high agglutinating power against the immunizing strain and a much less ($\frac{1}{20}$ of the high) agglutinating power against 3 non-immunizing strains, and negative results against 8 other *Bacillus coli* strains, 1 typhoid strain, and paratyphoid strains A and B. A similar chief agglutinin was obtained with the 5 strains used for active immunization.

Case III (G. K.) illustrates well the increment of agglutination which is essential, according to Klieneberger, for the proof of *Bacillus coli* immunization.

Mayer found one strain (R) which was usually agglutinated by normal serum diluted 1 to 100 (macroscopic test) and 1 to 250 (microscopic test), and other strains (M, N, L) with which agglutination was not obtained with sera little diluted. Strain M not only did not agglutinate well with normal serum, but was not readily agglutinated by serum (1 to 50) from an animal immunized to strain R, and did not produce agglutinins of any power when used for immunization.

This variation in the agglutinability and in the antigen for agglutinin in certain strains was the most interesting result of Mayer's investigation. Dead bacteria (*Bacillus coli*, twenty-hour cultures) gave stronger agglutinins and with more certainty than living bacteria when used for immunizing animals, an observation also made by Radziewsky (1900).

Bauermeister's case of general *Bacillus coli* infection, and later abscess of the testicle, was not carefully studied for agglutinins. An organism isolated from the abscess gave a "Widal" (?) 1 to 50, while the bacilli (*Bacillus coli*) from the blood and from the urine were not agglutinated; whether with the patient's serum or not does not seem clear. The bacillus isolated from the abscess—one and one-half years after the observations on the blood and urine—did not present the same cultural characteristics as those of the bacilli isolated from the urine and blood.

Jochmann, in 1906, recorded some interesting observations on infections of the urinary tract and general infection with the colon bacillus—two cases with an intermittent fever. In one case, following operation for carcinoma of bladder and subsequent catheterization, pneumonic signs developed, and later chills occurred, after which blood cultures with 20 c.c. of blood gave a growth of 10 colonies of *Bacillus coli*. In a second case, during a cystitis due to *Bacillus coli*, 8 colonies of *Bacillus coli* were grown from 20 c.c. of blood. Jochmann considered both these cases a blood invasion by *Bacillus coli*. In the first case Jochmann tested the agglutinating power of the serum against *Bacillus typhosus*, *Bacillus paratyphosus*, and several *Bacillus coli* strains. No reactions were obtained with *Bacillus typhosus* and *Bacillus paratyphosus*, and one strain of *Bacillus coli* was agglutinated by serum diluted 1 to 80, and the

Bacillus coli isolated from the patient was agglutinated by serum diluted 1 to 160. The patient's strain of *Bacillus coli* was agglutinated also by sera diluted 1 to 80 from four cases of acute cholelithiasis and by serum, diluted 1 to 320, from a protracted case of cholelithiasis; and a case of icterus with hepatic conditions and cholangitis gave a serum which, diluted 1 to 160, agglutinated the same strain of *Bacillus coli*. These cases he considered *Bacillus coli* infections. Jochmann tried 8 normal sera against the *Bacillus coli* strain from his Case I, and obtained reactions with dilutions no higher than 1 to 40. He thought a reaction with serum diluted 1 to 80 necessary to indicate infection with *Bacillus coli*, and that the reaction would be of value when no group agglutinins for *Bacilli typhosus* and *paratyphosus* were obtained. If the latter were present, one might still obtain a specific *Bacillus coli* reaction by saturating the sera (by absorption) after Castellani's method. Later, Jochmann tested the sera of 16 other *Bacillus coli* infections and obtained reactions with highly (?) diluted serum, so that he disagreed with Köhler and Scheffler, who claimed that such reactions are of no value. Jochmann also concluded that the homologous strain would agglutinate with more highly diluted sera than the heterologous strains, as stated by Pfaundler, which is contrary to the experience of Klieneberger and to our results.

Fehling's article deals mainly with infections of the genito-urinary tract during pregnancy and the puerperium. In one case of pyelonephritis in pregnancy, with fever for the fourteen days *ante partum* and at delivery, cultures from the blood were sterile; and cultures from the fetus were sterile. The fever disappeared on the fourth day of the puerperium, and the bacteruria persisted. Fourteen days after delivery the mother's blood, diluted 1 to 150, agglutinated a bacillus (*Bacillus coli*) isolated from the urine. He concluded that the *Bacillus coli* was in the mother's blood at the same time, admitting the possibility of agglutinating substance coming from the fetus through the placenta. From another case, following an obstetrical operation, he obtained *Bacillus coli* from the blood, urine, sputum, and sweat, and this case he considered the eighth of pure *Bacillus coli* sepsis recorded in the literature. No agglutination tests were carried out.

The nosological position to be given to the typhoid-like cases caused by *Bacillus coli communis* demands brief consideration. As in the case of typhoid-like infections by the intermediate members of the Typhaceae, it is impossible to differentiate these cases from infections by *Bacillus typhosus* by clinical methods alone. The assistance of the laboratory is required. Before the development of exact bacteriological diagnosis, all typhoid-like cases, by whatever member of the group they were caused, were considered as typhoid fever. The diagnosis was based necessarily upon clinical data. Since the discovery that the symptom-complex of typhoid fever

may be caused by several members of the Typhaceæ, the nosological position of these cases has been under discussion.

Two courses are open to us: to classify the cases clinically or bacteriologically. The former course is the simpler, and is followed in the case of many other diseases. Classification on a bacteriological basis necessitates the introduction of a separate term for each variety of infection. Therefore, we are inclined to advocate the classification of all cases of infection by the Typhaceæ, *when they pursue a typhoid-like course*, as clinical typhoid fever.

CONCLUSIONS. 1. Isolated reactions against *Bacillus coli* are without significance in respect to the cause of infection.

2. The blood serum of a case of infection by *Bacillus coli communis* may contain agglutinins for certain strains of this group while the infection persists and not upon the patient's return to health.

3. The detection of an increment of agglutinins in the blood serum for a particular strain of *Bacillus coli communis* is evidence of a local or general infection with that strain.

4. Some strains of *Bacillus coli communis* are capable of causing a disease clinically identical with typhoid fever.

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ACUTE SYPHILITIC DISEASE OF THE SPINAL CORD.¹

A DISCUSSION OF "SYPHILITIC SPINAL PARALYSIS."

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YEAR by year it becomes more firmly established that syphilis is the chief cause of acquired disease of the nervous system. The discovery of the spirocheta and the determination of the specificity of the serum reaction for syphilis have given firm foundation to what was previously presumption and conjecture regarding the dependency of certain diseases of the nervous system upon syphilis. Diseases that had been proved statistically to follow almost invariably in the wake of syphilis, like tabes and general paresis, but which some have contended were not syphilitic diseases because the lesions were not "characteristic" of syphilis, give a specific serum diagnostic reaction, and specific antibodies are demonstrable in the serum or cerebrospinal fluid, by a technique which as yet is unfortunately complicated.

There has been much discussion as to the manner in which syphilis attacks the spinal cord and as to whether or not there are different well-defined syphilitic diseases of that organ aside from tabes, which is now universally spoken of as a parasymphilitic disease. In 1892 Erb attempted clinically to differentiate a form of disease of the spinal cord which occurred exclusively in individuals who had previously suffered from syphilis and which resembled spastic spinal paralysis, differing from it, however, in a definite and characteristic way. It was characterized clinically by the triad of symptoms of spastic spinal paralysis *plus* some disturbance of the function of the bladder and slight subjective and objective sensory disturbance. He maintained that the occurrence of symptoms other than those mentioned made the diagnosis doubtful. The onset of the disease is usually slow and insidious, but sometimes more rapid, and improvement and long periods of standstill are possible. When Erb published his description of the disease no postmortem evidence from typical cases was obtainable. It seemed to him that the anatomical basis of the disease should consist of partial, symmetrically situated lesions in both halves of the cord in the dorsal region,

¹ Read at a meeting of the New York Academy of Medicine, October 1, 1908.

chiefly in the posterior lateral tracts, with partial involvement of the gray posterior columns and the white posterior tracts. He was unwilling to say positively what the nature of the lesion was, whether specific syphilitic infiltration, syphilitic infection of the vessels, or degenerative change. There was much corroboration of the existence of the disease from physicians in this country and aboard, but there was likewise much opposition to the acceptance of it, many maintaining that the disease was one that had long been recognized and was merely a gummatous myelitis, syphilitic disease of the vessels, or syphilitic meningomyelitis.

There have been nine or ten cases of typical syphilitic spinal paralysis that have come to autopsy since the publication of Erb's original paper. These cases are those of Westphal,² Eberle,³ Nonne (2 cases),⁴ Williamson,⁵ Dreschfeld,⁶ Long and Wiki,⁷ Wimmer,⁸ and Renner.⁹ The first cases that were investigated seemed to show that the lesion was that of a combined system disease, that is to say, a primary gray degeneration, in various fiber systems of the spinal cord, chiefly in the posterior half of the lateral tracts, the direct cerebellar tracts, and the tracts of Gowers; somewhat also in the posterior tracts, those of Goll and Burdach.

Nonne, ten years later, in 1902, demonstrated most convincingly that although syphilitic spinal paralysis was clinically a well-defined entity, it had by no means a constant, unvarying, morbid anatomy. He showed that the anatomical foundation of the disease might be: (1) A chronic, punctate, transverse myelitis, with ascending and descending degeneration; (2) a similar condition associated with primary degeneration of the pyramidal tracts; (3) degeneration of the pyramidal tracts alone; or (4) degeneration of the posterior and of the lateral columns (pyramidal tracts, direct cerebellar tracts, Gowers' tracts), a combined systemic disease. His study further showed that although the bloodvessels and the meninges may be diseased in syphilitic spinal paralysis, they may also be free from disease.

In a recent contribution of Nonne to the subject his contention has been further substantiated, as it has likewise been by the case of Wimmer and our own case.

The last case which Nonne published was that of a man who had had syphilis at thirty followed by vigorous mercurial treatment. When fifty-four years old he began to complain of difficulty in walking, slight radiating pains in the legs, and hesitancy in urination. Examination showed spastic gait, increased tendon jerks, slight

² Westphal's *Archiv f. Psychiatrie*, etc., 1897, vol. xxix.

³ *Münchener Abhandlung*, 1896, vol. i, No. 26.

⁴ *Deutsche Zeitschrift f. Nervenheilkunde*, 1905, vol. xxix.

⁵ *Syphilitic Diseases of the Spinal Cord*, 1899.

⁶ *Nouvelle Iconographie de la Salpêtrière*, 1902.

⁷ *Deutsche Zeitschrift f. Nervenheilkunde*, 1907, vol. xxxii.

⁸ *Ibid.*, vol. xxxiv, p. 451.

⁹ Erb, *Lancet*, 1902, vol. ii

ankle and patellar clonus, normal skin reflexes, some diminution of pain sensibility in irregularly distributed areas, and loss of the light reflex of the pupils. The cord showed a very slight punctate, chronic myelitic degeneration of the dorsal segments without secondary ascending or descending degeneration, but with very slight but unquestionable degeneration in Goll's columns of the cervical cord and the upper dorsal cord, as well as degeneration of the pyramidal tracts in the lumbar cord. In addition to these there was thickening of the bloodvessels without specific character, chronic endarteritis of the anterior spinal artery, and indefinite thickening of the meninges over the posterior part of the cervical and dorsal cord.

In 1902 Long and Wiki published their study of a case in which there was, in addition to punctate myelitis in the dorsal region, a degeneration of the lateral pyramidal tracts, direct cerebellar tracts, and Goll's column, and acute arteritis. The authors considered the tract degeneration to be secondary to the punctate myelitis, but Erb, in commenting upon the case, maintained that the main factor was a combined system disease with chronic sclerosis of the bloodvessels, by the side of which the rather diffuse chronic myelitic lesions in the dorsal cord appear etiologically as a quite permissible complication.

One of the most important cases that has so far been published is that of Wimmer. A man who had complained of periodic jabbing pains in his legs from the time he was thirty years old, became infected with syphilis when forty-five years old. He took active mercurial treatment, but eighteen months after the infection he developed typical syphilitic spinal paralysis, which ran a rapid course. About six months after the onset of the disease he developed cystitis and pyelonephritis, and died in a state of septicemia. The spinal cord showed the following lesions: (1) A focus of disease in the eighth and to a slight degree the ninth dorsal segments. (2) Slight meningeal changes in the dorsal and cervical cord. (3) Extensive bloodvessel affection. (4) Fairly extensive degeneration of Goll's column, the direct cerebellar tracts, a part of Gowers' bundle, and also the anterior uncrossed pyramidal tracts.

The case related by Renner is by no means typical of syphilitic spinal paralysis, and it should not be included in the category; the occurrence of optic atrophy and of ataxia of the upper extremities makes it impossible to include it in this category, but rather in that of tabes.

CLINICAL SUMMARY. *A youth aged twenty-three years, addicted to the intemperate use of spirits, became infected with syphilis September, 1907. Cutaneous and mucous membrane manifestations developed promptly. December, 1907, he had aphonia, due to syphilitic laryngitis. Six months after infection he developed weakness, stiffness and paresthesia of the lower extremities, and slight difficulty in urinating. The weakness of the legs intensified rapidly up to moder-*

ate paraplegia. This was promptly followed by retention of urine and later by incontinence of urine and feces, and impotency. After a very brief time he recovered sufficiently to leave the hospital, the symptoms at this time being those characteristic of syphilitic spinal paralysis. Cystitis and surgical kidney developed rapidly and he died eight months after infection, during which time he had been given mercury and iodide of potassium.

The patient, a young man aged twenty-three years, by occupation an actor, entered the City Hospital March 29, 1908, complaining of inability to walk, of numbness in the legs, of difficulty in discharging the urine and controlling the feces, and of huskiness of the voice. These symptoms, save the huskiness of the voice, had existed about a fortnight.

The mother, a paternal uncle and aunt had died of tuberculosis at an early age. The patient had been for several years addicted to the use of beer, whiskey, and absinthe. In August, 1907, he had an attack of gonorrhœa which lasted three months. In September, 1907, he became infected with syphilis, and in October a rash appeared upon the skin and mucous membranes. In December his voice became husky and soon he became unable to speak above a whisper.

Early in March, 1908, on the appearance of the nervous symptoms enumerated above, the aphonia suddenly disappeared. March 3 he received mercury hypodermically; the next day he complained of a numb sensation in the right leg, which he attributed to the injection. On March 6 he noticed weakness of the right leg. Next day it was difficult for him to walk or to stand, both legs being weak. At the end of the third day he was so paraplegic, he says, that he could not move the feet, legs, or thighs. Coincident with the occurrence of this motor paralysis he complained of a sense of numbness throughout the lower extremities, more noticeable in the hip than in the legs or the thighs. From March 6 to 9 he was unable to pass water, and it had to be withdrawn by catheter; after that he became incontinent both of urine and feces, but two weeks later retention again developed, and it became necessary to use the catheter again. A week after the onset of the paraplegia a bedsore formed over the sacrum.

He was quite positive that previous to the onset of the paralysis there had been no symptoms indicative of brain or spinal cord disease, no headache, dizziness, disturbance of function of the special senses, nor pain.

March 24, 1908. On the patient's arm and back a fading syphilitic eruption is still to be seen. On either side of the neck is a chain of enlarged indurated lymphatic glands. Over the sacrum is a bedsore about as large as the hand. The patient cannot stand, and he cannot raise himself in bed save by the assistance of the arms. The lower extremities can be flexed and extended, abducted and

adducted, all feebly and with considerable spasticity. The tendon jerks of the lower extremities are lively. The Babinski and the Oppenheim phenomena are elicitable in both lower extremities. Tactile sensibility is very much blunted in both feet and ankles, and there is slight hyperesthesia of the legs. The temperature sensibility is likewise diminished in the feet and legs, but pain sensibility is preserved. There is no atrophy of the lower extremities. The upper extremities are unaffected. There are no pupillary disturbances and no involvement of any of the cranial nerves.

Bichloride of mercury was administered hypodermatically and attention was given to the bladder and bowels. Examination of the urine made on many occasions showed the presence of a faint trace of albumin, a considerable amount of pus, many epithelial cells, and a diminution of the total solids. Examination of the blood showed an approximately normal condition, with an increasing number of leukocytes. When he left the hospital, on April 28, he had made considerable improvement; the bedsore had very nearly healed, and he was able to walk with the aid of a stick; his gait, however, was typically spastic, but the muscular rigidity was comparatively slight.

While out of the hospital he received an injection of salicylate of mercury and 120 grains of iodide of potassium daily. On April 30 he complained of sensations of weight in the stomach, of nausea, and of vomiting; likewise of a sensation of tenderness of the spine, as though he had been beaten. From that day until his reëntrance to the hospital May 4, headache and dizziness were also distressing symptoms.

Examination at this time showed very similar conditions to those existing when he left the hospital. He was able to walk without assistance, the gait being one of enfeeblement and spasticity. The power of flexion and extension of the legs and thighs was very little impaired. All the tendon jerks of the lower extremities were increased, the Babinski phenomenon and ankle clonus were present. The abdominal and cremasteric reflexes were not elicitable. The upper extremities and cranial nerves showed no abnormalities. The lower extremities were slightly spastic.

Examination of the sensory state of the lower extremities showed postural sensibility normal, tactile sensibility very slightly obtunded in the feet, and thermal sensibility was more impaired than any other form. On the legs he did not readily distinguish warm from hot objects, and unless the object was very hot he did not distinguish heat from simple touch. In the thighs, however, warm and hot were distinguishable all over, and cold readily. There was slight ataxia of the legs, most manifest when he attempted to put the heel of one foot on the knee of the other leg.

On May 7, 1908, that is three days after his readmission, he developed symptoms of septic pyelitis, septic infarct, pain in the left

loin particularly on micturition, pinched expression of the face, profuse perspiration over the entire body, feeble pulse, and elevation of temperature. Cystoscopic examination showed the mucous membrane of the bladder much injected, its folds considerably swollen. The ureters were not catheterized. Rectal examination was negative save that it showed the sphincter to be of fairly good tone.

On May 20 nephrectomy of the left kidney was performed, which the patient did not long survive.

SUMMARY OF PATHOLOGICAL CHANGES. *Areas of softening, principally in the posterior half of the cord on transverse section, extending from the first to the ninth dorsal segments, associated with changes in the bloodvessels, thickening and round cell infiltration of the vessel walls, circumvascular exudation, vascular thrombosis and hemorrhages; syphilitic myelitis; sclerotic patches due in part to growth of glia cells, principally toward the periphery of the cord, especially of the posterior and posterior lateral tracts; secondary degeneration of the posterior columns, especially the column of Goll and also of the direct cerebellar tract and Gowers' tract in the upper thoracic and cervical regions; slight, but distinct, productive meningitis, patch-like distribution in many thoracic segments. The cells of Clarke's column much degenerated; those of the anterior horn suffering to a much less extent, possibly the effects of sepsis.*

When the spinal cord was removed the thoracic portion was noted to be of less firm consistency than normal, and when cut across, reddish brown areas, resembling hemorrhagic foci, were seen macroscopically. These were more striking after the cord had hardened. On sectioning the cord these areas of softening appeared and disappeared, having a wide distribution, from the first to the ninth dorsal. They were, however, most conspicuous in the mid-dorsal region, and were situated largely in the interior of the cord, in the middle and the posterior thirds. They involved, at different levels throughout the diseased portion, the posterior columns, the posterior horns, and the lateral columns in the region of the posterior horns, also the gray matter in the vicinity of Clarke's column, the lateral horns, and in one instance the anterior horns. There were about seven of these areas in all, most of which did not extend through more than one segment of the cord, the greatest extent being three segments. Many sections through the affected region did not present these softened areas.

Examined after appropriate hardening and staining, the vascular alterations are most striking, veins, arteries, and capillaries all being involved. The branches of the posterior spinal vessels are more uniformly affected, both the large and the small, the meningeal and the medullary; but over a small extent the anterior vessels are as seriously diseased as the posterior.

Many vessels exhibit marked endarteritis, distinctly hyaline in character, with more or less narrowing of their caliber. This is a

prominent feature of the capillaries in the cord substance, where, in certain areas of softening, minute hemorrhages have invaded the surrounding tissues and red blood cells have migrated far from their source. These hemorrhages are to be seen in the gray matter, especially in the region of Clarke's column, in the posterior columns, and to a less degree in the lateral columns (Fig. 1). One of these areas, circular in outline and situated at the ventral end of the posterior column, is riddled with erythrocytes, but no bloodvessels from which they might have come is discernible. In close proximity to these thickened capillaries are other thin-walled capillaries, the larger of which lie in wide perivascular spaces and are enormously engorged to the size of the large meningeal arteries; the smaller,



FIG. 1.—Dorsal cord showing hemorrhages in the region of Clarke's column, the posterior columns and the lateral tracts, and the secondary degeneration.

poorly formed and more numerous, are budding bloodvessels. In those sections which show the changes in the anterior gray matter of the cord, the artery of the anterior fissure and the ventral meninges are thickened, and show slight hemorrhages. Perivascular thickening is frequently encountered, and there is extensive proliferation surrounding many meningeal vessels.

The circumvascular cellular infiltration, which is very conspicuous, is significant of the acuteness of the process (Fig. 2). Comparatively few vessels, large or small within the stated limits of the lesion escape

this round-cell infiltration, and many of the vessels in the cervical and lumbar regions show it to a marked degree. It is noticeably more frequent, however, in the posterior half of the cord, where many vascular spaces are widened; and tortuous vessels, running from the periphery, especially those cut longitudinally, show varying numbers of round cells lying both in their walls and in their circumvascular lymph spaces. Meningeal vessels frequently display profound cellular invasion, which, uniformly, has its origin in the proliferated outer coat, and may ultimately involve the entire wall, so that occasionally a vessel, solid with round cells, is wholly obliterated (Fig. 3). Vessels in the vicinity of those seriously diseased show comparatively minor changes, and there is no ratio between the thickening and the infiltrating processes.

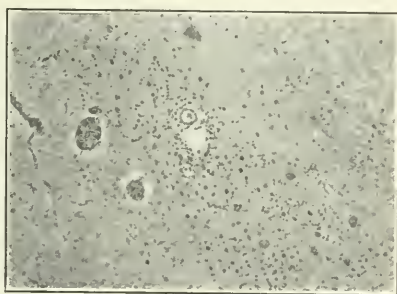


FIG. 2.—Circumvascular cellular exudation and thrombosed vessels.

The round cells are of the lymphocytic variety, having a thin layer of protoplasm surrounding a nucleus, fairly regular in outline which stains black. In the cord these round cells are almost wholly confined to the bloodvessels; in the meninges, however, they infiltrate the tissues, seeming to travel along the lymph spaces (Fig. 4).

These vascular alterations, evidently syphilitic, are of a true inflammatory character. They and the pathological alterations, which condition patchy softening in the parenchyma and the glia tissue of the cord, constitute a true syphilitic myelitis.

The areas of softening are evidently of recent origin, and while some of them show budding bloodvessels, the glia replacement is only of a moderate degree. The cells are of two types, the normal having an opaque nucleus staining more darkly than the other; it is larger, more definitely granular and translucent, varies in outline, and shows a tendency to disintegrate. The destruction of the nervous elements, in most cases only partial, is characterized by swelling of the axones, bulging and disintegration of the myelin sheaths, with ultimate disappearance of both nervous elements, large perforations remaining. It is not uncommon to find intact axis cylinders persisting after complete destruction of the medullary sheaths.

Small patches of degeneration, made conspicuous after staining and showing decided preference for the posterior columns and the



FIG. 3.—Profound involvement of meningeal vessels and thickened meninges.

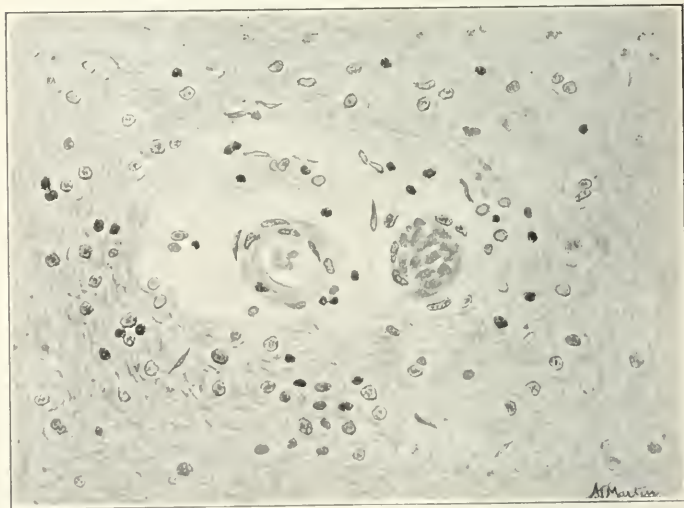


FIG. 4.—Area of softening; illustrating inflammatory character of the vascular alterations.

posterior half of the lateral columns, border the periphery of the cord like dipping pia, radiate more deeply into its substance, and lie

isolated almost anywhere in its interior (Fig. 5). Some of these patches are sharply defined, and these frequently follow the course of the bloodvessels. Others are more or less devious and irregular in outline. In keeping with the size and number of these evidently primary foci, there is destruction and disappearance of the nervous elements.

On cursory examination, the pia seems to be only slightly diseased, but careful examination shows numerous well-defined patches that are moderately thickened from true proliferation and more or less infiltrated with round cells. These areas are found in both the



FIG. 5.—Patches of degeneration of irregular distribution, but principally of the posterior columns, and thickening of the meninges.

anterior and posterior surfaces of the cord, mostly in the posterior, and to a much less extent in the lateral aspects. Hemorrhages are also seen in the meninges (Fig. 6). The dura was intact.

As might be expected, the ganglion cells appear to be well preserved except in the vicinity of the lesions noted above. In these regions the cells of Clarke's columns show frank degenerative processes of varying degrees from slight central chromatolysis to complete chromatolysis, eccentric, shrunken, or absent nucleus, and atrophy of the cell. To a less extent, the lateral and anterior horn cells share in these changes (Fig. 7). The secondary degenerations are enumerated in the summary, and are depicted in the illustrations.

COMMENT. We do not maintain that this is an example of syphilitic spinal paralysis. It does not conform to that disease either in its onset or in its early symptomatic display. A slow and insidious onset is considered quite characteristic of the disorder which Erb described. In the case that we report the onset was abrupt and paraplegia developed within a few days; but the point to which we particularly wish to draw attention is that this paraplegia soon disappeared and the patient left the hospital. When he left the hospital he was clinically an example of syphilitic spinal paralysis. He had spastic gait, increased tendon jerks, muscular hypertonus, sensory disturbance

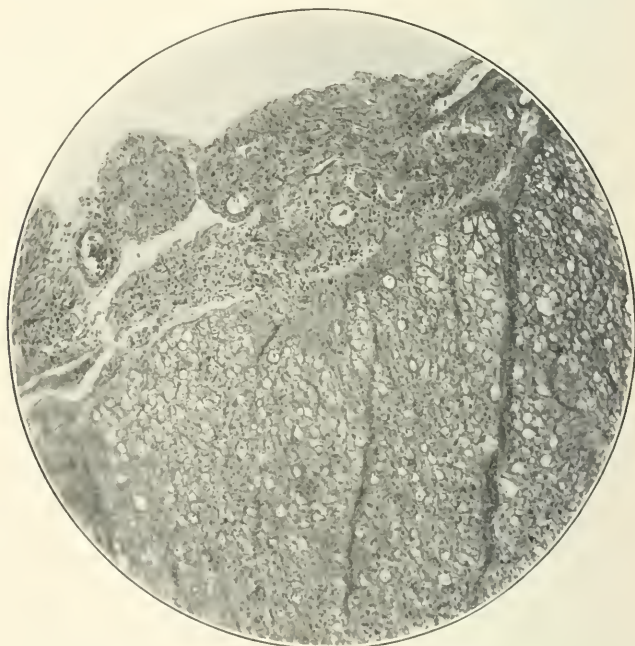


FIG. 6.—Careful examination shows well-defined patches of true proliferation in the meninges and hemorrhages.

in the lower extremity, and disorder of the function of the bladder. Practically he had no other symptoms until the acute septic condition occurred. Had he been examined for the first time on his return to the hospital and without the history of previous paraplegia, we should have had no hesitation in making the diagnosis of syphilitic spinal paralysis. Moreover, had his course of improvement been unbroken by the septic condition which overtook him, there can be no doubt that he would have eventuated in a typical example of this disease. Therefore we venture to believe that the pathological findings of this case are of great importance as indicating the anatomical foundation of some cases of syphilitic spinal paralysis.

For instance, the patient whose history is summarized below is today considered a case of syphilitic spinal paralysis, and yet at the onset of his disease he presented a parallel to the case that we publish herewith. A man, who contracted syphilis when twenty-two years old, and who received mercurial treatment by the mouth for three months, was seized four years after syphilitic infection with a weakness of the lower extremities, which within twenty-four hours reached such a degree that he was unable to stand or to walk; accompanying this there was inability to void the urine, followed by incontinence, inability to control the rectal sphincters, and a sensation of numbness,



FIG. 7.—Sharply defined degeneration of the columns of Goll in the cervical region and of the direct cerebellar tract.

“weight” and “dead” feeling of the lower extremities. He gradually recovered strength in his lower extremities, and a few weeks afterward he went to the neurological department of the Post-Graduate Medical School, where he was seen by one of us.

He was given active mercurial treatment and soon disappeared from our observation. The day following the reading of this paper, that is, twelve years after his first examination, he reappeared in the Clinic. In this interval he had been earning a livelihood as a canvasser. His complaint was of stiffness and weakness of the lower extremities, hesitation in starting the urinary stream, occasional hurried action of the vesical sphincter, impotency, and paresthesia

of the lower extremities. The physical signs were exaggeration of all of the jerks of the lower extremities, the Babinski toe phenomenon, and a slight amount of rigidity, with marked spasticity of walking and a slight but distinct hypæsthesia. In other words, he is today an absolutely typical case of Erb's syphilitic spinal paralysis.

We repeat, therefore, that the case whose anatomical details are herewith published may be looked upon as an important contribution not only to the morbid anatomy of the disease but as an indication of how the disease may develop and comport itself as well.

From a pathological standpoint the example that we present is one of syphilitic myelitis. The changes in the bloodvessels, the true inflammatory softening, the patches of productive meningitis, slight though they be, are in support of this statement. Contrasted with the case of Wimmer and with the case of Long and Wiki and of Williamson, it is parallel in many respects both clinically and pathologically. It is quite conceivable that if the patient had lived, inflammatory and neerotic foci would have been replaced by connective tissue, and that if his spinal cord had been examined ten years later, the secondary degeneration and connective tissue replacement would have been the striking pathological features, while there would scarcely be any evidence of inflammatory disease. The examination of an example of the disease in its incipieney, such as this one, shows that some cases, at least, of syphilitic spinal paralysis are dependent upon syphilitic myelitis.

The manner in which the diseased bloodvessels radiate to the inflammatory foci is very suggestive of the pathogenesis of the disease, particularly as we know that the spirochetes travel along the sheaths of the bloodvessels. The destruction of the tissue of the spinal cord substance may be due to the direct activity of the spirochetes themselves, to toxins which they manufacture, or it may be due to the œdema consequent upon the inflammatory reaction. It is much more legitimate to conceive this to be the cause of the destruction than to make it dependent upon disease of the bloodvessels. In some places the softening has no apparent relationship to bloodvessels whatsoever; there is simply an œdema, a round cell proliferation, and a resulting fragility of the focus.

The complete and clean-cut degeneration of Goll's column in the upper dorsal and the cervical regions is undoubtedly secondary degeneration, and we are inclined to the opinion that the ascending and descending degeneration in Gowers' tracts, and the descending degeneration in the pyramidal tracts is likewise secondary.

HABITUAL OR RECURRENT ANTERIOR DISLOCATION OF THE SHOULDER.¹

I. ETIOLOGY AND PATHOLOGY.

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PROBABLY few major operations in surgery have more brilliant records, and at the same time have received less attention from the profession, than that of capsulorrhaphy for habitual or recurrent dislocation of the shoulder. The number of recorded cases in which this operation has been performed, while small, is still large enough, and the good results positive enough, to establish its claim for recognition. The greatest attention has been given to it by the French and the Germans, though few of their surgeons have operated on more than one case, Francke² and Perthes³ alone having operated on four. Souchon,⁴ in his elaborate paper on irreducible dislocations of the shoulder, seemed to include the habitual or recurrent as a variety of the irreducible, and drew no distinction between the two forms, so that one is led by his paper to infer that the frequently unfavorable results of operation for the irreducible apply also to the habitual or recurrent. The pathology and the result of operative treatment, however, differ substantially.

FREQUENCY. Statistics on the frequency of this condition could not be found. It has been said that an example of it exists in every village. I have been surprised by the frequency with which I have met with cases since operating on my patient. From casual references to the subject, and through the efforts of the patient operated on, I have seen or heard of 16 cases. The frequency of the recurrences varies widely in different cases. In one of Francke's there were five recurrences in four months; in another they occurred "recently" almost daily; and in still another, several times a day "finally." The great majority of the cases recorded in the literature recurred much less frequently. The longest intervals between the recurrences with which I am familiar occurred in one of the 16 unrecorded cases. This patient received his first dislocation in a fall from an old-fashioned, high-wheeled bicycle, about twenty years ago. With fair regularity, the recurrences have occurred at about three-year intervals. In another of these 16 cases the luxations took place about every two years, for twenty years, and then ceased to occur. There is still, however, a "snap"

¹ Read in abstract at a meeting of the Philadelphia County Medical Society, October 14, 1908.

² Deut. Ztschr. f. Chir., 1898, xlviii, 399.

³ Ibid., 1906, lxxxv, 199.

⁴ Trans. Amer. Surg. Assoc., 1897.

or "give" on extreme abduction of the arm, indicating, probably, that the dislocation would occur from much less violence than would be necessary to produce it in the normal shoulder. Occupation has much to do with the frequency of the recurrences. The patient mentioned, for instance, has been well able to train himself to the necessity of keeping his arm at his side, or of preventing the dangerous movements; so that the infrequency of the recurrences and the final disappearance of them, in his case, may be explained in this way. Most patients cannot do this. Their occupations or inclinations compel them to abduct the arm and to take the chances of a recurrence. With each repeated luxation the facility for repetition is usually increased, sometimes to such an extent that only a turn in bed is necessary, as in Joseph Muller's⁵ and Hildebrand's⁶ cases.

IMPAIRMENT OF FUNCTION. The degree of disability varies considerably, but is always a serious matter to the patient, and may sometimes prevent him from following his usual occupation. Thus, Krumm's,⁷ Samosch's,⁸ and one of Perthes' patients were unable to work, and another of Perthes' patients was almost incapacitated. Generally, after a few recurrences, the patient is afraid to place his arm in the abducted position, and when he makes the attempt to do so he is seized with a "panicky" feeling from fear of a recurrence. Sometimes a mere rotatory movement at the shoulder will throw it out, so that the resulting limitation of motion greatly incapacitates the patient. I know of one patient who binds his arm to the side of the body during sleep to prevent a recurrence.

Generally, in the interval between the recurrences, there is little or no disability in the shoulder beyond the limitation of movement due to fear of recurrence; but in some cases, immediately following each luxation and its reduction, there is distressing pain in the shoulder, and in some, swelling. When, in such a case, the recurrences are frequent, the patient may be in continual distress. In one of Perthes' cases, although the last luxation had occurred two months before, the patient was still carrying the arm in a sling, to avoid painful movements.

CAUSES. The causes which Stimson⁹ discusses at some length, and seems to regard as important, may be grouped as follows: Defects in the head of the humerus; defects in the glenoid cavity; rupture of the outward rotators of the humerus or avulsion of the greater tuberosity; detachment of the capsule from the anterior margin of the glenoid cavity; and enlargement of the joint from relaxation of the capsule. Bardenheuer,¹⁰ in his work on injuries of the upper extremity, rejects as a cause the healing of a capsular tear

⁵ Münch. med. Woch., 1900, xlvii, 1380.

⁶ Archiv. f. klin. Chir., 1902, lxvi, 360.

⁷ Münch. med. Woch., 1899, 986.

⁸ Beiträg. z. klin. Chir., 1896, 803.

⁹ Fractures and Dislocations, 1907.

¹⁰ Die Verletzung der oberen Extremitäten, Stuttg., 1886, pt. ii, p. 414.

enlarging the joint, suggested by Malgaigne. The communication of the joint with the subscapular bursa through an abnormally wide opening (Roser), he apparently accepts. The relaxation of the capsule, he thinks, is dependent upon the distention due to the accompanying hydrops. Diminution of the size of the humeral head from the associated defects, he says, has the same effect as enlargement of the capsule. While there is a considerable difference of opinion as to the relative importance of these causes, and although a few of them have been rather generally excluded, there seems an inclination to discuss them, indicating that we are still in the stage of uncertainty as to their significance. The unity of the profession as to the pathology of this condition has not yet advanced far beyond the position of Bardenheuer, who suggested that the causes are very little understood.

In the presence of so much confusion, there is a refreshing simplicity in the proposition of Ricard,¹¹ that the only important factor is the enlargement of the capsule. He did nothing to prove this, except to present the argument that in the interval between the recurrences, often prolonged, the joint can functionate in a manner altogether normal. This, he says, shows that the lesion is limited to the capsule, and is a simple diuresis with integrity of the other articular and periarticular structures, skeleton, and musculature. In his two operations, he determined the integrity of the intra-articular structures by palpation through the unopened capsule. He appeared to ignore the findings in the autopsy and postoperative specimens, which had been reported before the appearance of his paper. Interesting changes have undoubtedly occurred in the head of the humerus and the glenoid cavity, and much has been written of the tearing of the muscles inserted into the greater tuberosity or of the tuberosity itself. They continue to receive much attention as causal factors from writers on this subject, although the increasing number of operations tends to strengthen the Ricard idea. One of the chief results of my study of this condition is the firm conviction that the essential lesion is the tear in the capsule which permitted the first escape of the head of the humerus from the glenoid cavity, and that the other lesions, which have been variously interpreted, are of secondary importance.

PATHOLOGY. No one, so far as I have been able to learn, has yet made use of experimental luxations of the shoulder on the cadaver, in elucidating the recorded findings at autopsy and operation. Allis' classical work on dislocations of the hip was based almost exclusively upon his experimental investigations on the cadaver. What occurred in the cadaver he assumed occurred in life, and I am not familiar with any serious objection raised against his conclusions. During the past nine years I have produced on the

¹¹ Verneuil, Bull. d. l'Acad. d. med., 1894, xxxi, 330.

cadaver many anterior dislocations of the shoulder for demonstration in the lectures of J. William White, professor of surgery, and G. G. Davis, associate professor of applied anatomy, in the University of Pennsylvania, and have dissected a considerable number of such specimens. Some of these dissected specimens have left in position only the torn ligaments and the bones, others the muscles in addition, and some the important bloodvessels and nerves. These specimens were used in conjunction with other dislocations on the cadaver in which no dissection was made. During these years I have come to recognize as constant and most important in the specimens the tear in the anterior and lower portion of the capsule, through which the head of the humerus had escaped (Figs. 1 and 2). The dislocations were invariably produced by abducting the arm at the shoulder until a tearing was felt or heard,

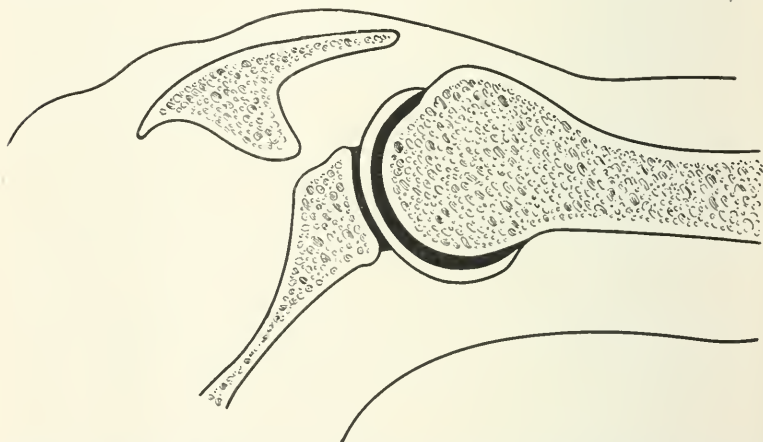


FIG. 1.—Diagrammatic section through the shoulder-joint, with the arm at right angles to the body, showing normal relations of the head of the humerus to the glenoid cavity and capsule.

when the head was forced under the coracoid process with the aid of rotation, internal and external. It is assumed here that it is generally accepted that anterior luxations of the shoulder are essentially due to abduction at the shoulder. Dissection, so far as my memory supports me, invariably showed a tear of the anterior and lower part of the capsule, and almost, if not always, from the glenoid margin, only the posterior part of the capsule remaining intact. We know that the effectiveness of Kocher's method of reduction in anterior luxations of the shoulder depends upon the untorn posterior portion of the capsule, just as Bigelow's circumduction method at the hip-joint depends upon the intact anterior part of the capsule at that joint. Allis has pointed out that the capsule in hip luxations, sometimes tears from the acetabular margin, sometimes obliquely from the acetabular to the femoral attach-

ment, and at other times from the femoral attachment. He has also shown that in the last instance the head of the femur during reduction of the luxation may push before it into the acetabulum the torn portion of the capsule now hanging from the posterior acetabular margin. I have never seen a tear of the shoulder capsule at its humeral attachment, nor one passing obliquely from the glenoid to the humeral attachment, although, because of a lack of interest in this particular point, such might have occurred and have been overlooked or not exposed. Joessel¹² reported a case of recent luxation of the shoulder which came to autopsy, showing such a tear, which he made use of in his efforts to prove that the important tear in the capsule in all the recurrent cases is at the attachment of the supraspinatus and infraspinatus muscles to the greater tuberosity. I recall one cadaver specimen in which, in addition to the usual ante-

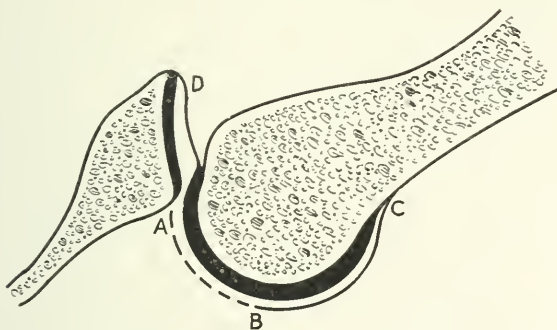


FIG. 2.—Diagrammatic section through a recurrent, anterior dislocated shoulder, with the arm in marked abduction. *B*, edge of the rent in the capsule, torn from *A*, the margin of the glenoid cavity; *C*, normal attachment of the capsule to the anterior part of the anatomical neck of the humerus; *D*, posterior untorn portion of the capsule; *A, B, C*, hernial pouch of the capsule resulting from the luxated position of the head of the humerus; *A, B*, new or cicatricial portion of the capsule; *B, C*, old or original portion of the capsule.

rior capsule tear, there was an opening into the joint posteriorly, due to the tearing off of the greater tuberosity by the attached supraspinatus and infraspinatus and the underlying capsule. In connection with the earlier specimens, such a condition did not particularly interest me, but so far as I can recall, this was the only one in which such a tearing off of bone was observed. A tearing of the muscles themselves cannot be recalled. Since beginning this study five cadaver specimens of anterior shoulder luxations have been examined, and in none of them was there any tear of the capsule, except the usual anterior one, which, in all of these, occurred from the anterior and lower glenoid margin and extended from the origin of the long head of the biceps above, to, or beyond that of the long head of the triceps below. The only exception to this in my experience was found in the case operated upon, in which it was seen clearly

¹² Deut. Ztschr. f. Chir., 1880, 167.

during the operation that the tear of the capsule occurred not at the glenoid margin, but about a half inch below and parallel to it. It extended from the level of the long head of the biceps above to at least that of the long head of the triceps below. The evidence of a tearing of the capsule from the glenoid margin in the collected cases is scanty, but it was found in some. Indeed, some surgeons, for instance, Cramer¹³ and Küster,¹⁴ could find no evidence of any tear of the capsule. This is, probably, present in every complete luxation at the time of the accident. It always occurred in the cadaver, that is, in every specimen examined. One would expect that a piece of bone would be broken off at times from the glenoid margin and that the glenoid cartilage, which deepens the cup, would be more or less disturbed. This is due either to the striking of the humeral head against the glenoid edge, or the pull of the capsular ligament. In Kraske's¹⁵ case there was a piece of bone torn from the glenoid margin, so that the fossa was narrower below than above. It is normally wider below. Popke¹⁶ said that the capsule was torn away from the deformed glenoid cavity in his case. In Broca¹⁷ and Hartmann's specimen the capsule was torn away from the anterior glenoid margin, but it still remained continuous with the periosteum of the front of the neck of the scapula, which was lifted from the bone, forming a pocket into which the head of the humerus escaped. Schüller¹⁸ noted that the anterior glenoid margin was torn off. Below it was jagged, suggesting a fracture there. He refers to experimental luxations in which such fractures were not infrequent. In Sick's¹⁹ case the glenoid cartilage was destroyed from the lower end of the cavity up to the insertion of the long head of the biceps. The bone in this area was smooth and sclerotic and its cartilaginous margin jagged. Wiesinger²⁰ said that there was no tear of the capsule in his case, but a separation of it from the margin of the glenoid cavity, below and internally, through which the head had escaped. Franke found in one of his cases a piece of bone, which he said was probably torn from the glenoid cavity, although the corresponding place could not be exposed through the small incision. Hildebrand, in both of his cases, found a marked defect in the anterior margin of the glenoid cavity, and a corresponding movable piece of bone.

After reduction of a recent anterior dislocation of the shoulder, the arm is usually bound to the side of the body. This position will approximate the torn margins of the capsule or the upper torn margin to the corresponding border of the glenoid cavity, from which it was torn, and if sufficient time is permitted in this position

¹³ Berl. klin. Woch., 1882, xix, 21.

¹⁴ Verhandl. d. Deut. Gesellsch. f. Chir., 1882, xi, 112.

¹⁵ Ibid., p. 113.

¹⁶ Zentralbl. f. Chir., 1883, x, 28.

¹⁷ Bull. d. l. soc. Anat. d. Par., 1890, lxxv, 422.

¹⁸ Berl. med. Woch., 1890, xxvii, 760.

¹⁹ Jahrb. d. Hamburgischen Staatskrankanstalten, 1891-1892, iii, 374.

²⁰ Deut. med. Woch., 1895, v, 116.

the gap will be closed by cicatricial tissue. If, however, the pain largely disappears in a few days, as Stimson says it may do, and the joint can be freely used, the patient may, as did mine, go about without a dressing and in a short time use the arm almost as freely as before the luxation. Of course, under these circumstances the gap is not firmly closed when movements are begun; and when the arm is raised to the abducted position, a contraction of the adductor muscles of the shoulder may pull the head into the dislocated position. It is well known that progressive recurrences are usually more and more easily produced and reduced. The new space formed by the dislocated head (Fig. 2, *A B*) tends to become permanent and then becomes lined by a smooth surface, which has been observed on examination of the internal surface. This results probably from an extension of the normal endothelium from the margins of the original tear, and is reinforced externally by connective tissue, probably from a combination of the surrounding fascia and cicatricial tissue. It has been described as being of varying thickness, usually, as in my case, being thin and weak. Küster spoke of it as being thickened by cicatricial tissue. The enlargement of the capsule, which was noted as being present in practically all the cases, is due to the cicatricial new portion added to the old capsule, and is not the result of relaxation of the capsule, as has been suggested so often. Bardenheuer and others accounted for it by assuming a distention of the capsule from the accompanying inflammatory hydrops. It is surely not a gradual enlargement, but the space necessary for the dislocated head is just as large at the time of the accident as during any of the later recurrences. In my case the two margins of the original capsule tear were found and sutured together, and when this was done the original capsule seemed to be reformed without enlargement. The statements made by various writers to the effect that no tear of the capsule was found, that the capsule or joint was enlarged, or the capsule dilated or relaxed, are thus readily explained. The new, cicatricial portion of the capsule formed about the new space made by the dislocated head was not distinguished by the various operators from the old or original portion, because of the limited exposure in the deep wound.

Having stated briefly my explanation of the pathology of habitual or recurrent dislocations of the shoulder, I will consider the most important of the opposing theories with the object of showing how much they depend upon fact and how much upon misinterpretation.

Defects in the Head of the Humerus. Very striking defects have been observed, sometimes as much as a third of the surface of the head having disappeared. They are of importance chiefly because they have been made the basis of resection of the head in a considerable number of cases. A head diminished in size was considered to have very much the same causal effect as an enlarged capsule,

and the principle of the operation was that if there was no head there could be no luxation. It was always followed by a cessation of the recurrences. A very striking feature of these defects was that they were always found in the same portion of the head, the posterior and outer part of the articular surface rather below the greater tuberosity, frequently bordering on the anatomical neck. A few writers, like Perthes and Joessel, reported them as existing at the site of the greater tuberosity, but the other reported specimens (autopsy or resected) do not show the tuberosity involved. If the greater tuberosity is not involved, then the defect cannot be the result of a tearing off of the insertion of the supraspinatus and infraspinatus muscles, which is an important point. They are usually near the tuberosity, but not of it. In addition to being in the same part of the head, they are frequently of the same shape, boat-shaped, wedge-shaped, etc. As to the size of the defect, Broca and Hartmann's specimen stands probably alone. The head in this specimen looked like an orange with a quarter segment removed, which involved the whole posterior part of the head. Usually the defect is shallow, frequently only the cartilage being taken off. It was also noted frequently that in the luxated position the defect in the head rested on the anterior margin of the glenoid cavity. The area of the defect was usually deprived of cartilage, although occasionally microscopic examination showed small cartilaginous spots in it. It was usually covered by sclerotic, smooth bone, sometimes in part by a thin fibrous tissue. Sometimes there were joint bodies present made up of bone and cartilage, free or attached, and in rare instances, as in one of Francke's cases, the body fitted exactly into the defect in the head, showing that the defect and body resulted from a breaking off of a piece of the head. In other cases no such joint body could be found, and in these the defect has been explained variously: by some, as the result of the wearing effect from pressure of the head against the anterior margin of the glenoid cavity; by others, as the result of a fracture, the fragment having been absorbed.

Although pressure of the glenoid margin may have a wearing effect on the posterior surface of the head, as suggested by Löbker,²¹ it seems evident to me that these defects have their origin in the first luxation. While it is generally recognized that the luxation is the result, chiefly, of abduction, there is no doubt that the head goes out through the rent in the capsule with considerable violence, due to the force of the fall on the shoulder, elbow, or hand, which is probably the usual accident producing the first luxation. As the head is being jammed forward into the luxated position it is the posterior part of the cartilaginous surface of the head which strikes against the anterior glenoid margin. In an autopsy specimen of a recent luxation, Sick found a defect of the

²¹ Verhandl. d. Deut. Gesellsch. f. Chir., 1888, xv, 210.

head, 3.5 cm. by 3.5 cm., at the usual site. The degree and nature of the injury to this portion of the head will evidently depend upon the force acting and the directness with which it is met and resisted by the glenoid margin. The result may be a fracture of the head, a scraping off of its surface, or a dent in it. In the majority of the cases the head probably escapes uninjured, at least in many operations a defect was searched for and was not found. It is possible that in many of these it was so slight as to be overlooked. During the production of the luxation the corresponding glenoid margin may be partly ground off or the glenoid cartilage overlying the circumference of the fossa may be torn or crushed. While in a number of specimens it was noted that the defect in the head rested on the anterior margin of the glenoid cavity, in only two was it shown that there was a close fitting of the one into the other, proving conclusively a wearing effect. In Broca and Hartmann's specimen the marked defect in the head fitted closely over the anterior margin of the glenoid fossa, which showed no appreciable loss of substance. In Löbker's specimen the defect in the head, in a similar manner, in the luxated position, fitted over a prominent border separating the larger inner half from the smaller outer half of the glenoid cavity. These surfaces formed an angle, the inner articulating surface sloping inward and forward from the outer. In both these cases it is seen clearly that a wearing effect had been produced by the pressure of the two opposing bony surfaces. Broca and Hartmann's specimen was obtained from a patient who was admitted to the hospital unconscious and died almost immediately. He presented all the signs of an antero-internal dislocation of the right shoulder, upon which no attempt had been made at reduction. During the dissection there was a sudden jump, and the luxation was reduced. It was noted that this was clearly not a recent luxation. With no history of the case, there could have been no knowledge of the frequency of the recurrences and the period during which each recurrence had persisted, so that there might have been a more or less permanent subluxated position, when the long-continued pressure of the opposing surfaces would account for the marked wearing of one on the other.

Löbker argued from his case a like condition and cause for all other reported cases showing defects of the humeral head. Of this specimen Stimson says: "The symptoms presented by Löbker's case during life are not given, but it does not seem possible that they could have been, at least at the last, such as are found in habitual dislocation, for that is characterized by complete restoration of form in the intervals between the recurrences, while in this case the subluxation must have been persistent." Löbker, in explaining the formation of these defects in the head of the humerus and the glenoid cavity (his was the only reported specimen I found that showed such a deformation of the glenoid), says: "After

a large number of recurrences and long years of existence of the trouble, a reduction of the head into the glenoid cavity is no longer possible." This statement is not supported by other writers. The chief characteristic of recurrent luxations, as shown by the other reported cases, is that in the intervals between the recurrences the joint is, apparently, perfectly normal, except for the tendency to relaxation. Löbker, evidently, had no history of recurrent luxations in his case, the specimen having been obtained from a cadaver in the course of operative surgery, and it is likewise evident that he did not succeed in reducing the luxation on the cadaver. The only conclusion that I can reach, after studying Löbker's report, is that he had a specimen of a permanent subluxation of the shoulder, and that it has received unmerited attention from a large number of the writers on this subject. It has only served to confuse our conception of this condition. R. W. Smith²² reported the autopsy findings in a double subcoracoid dislocation, with an excellent illustration. The history of this condition during life was not known, but the description of the shoulder-joint, in my opinion, shows the case to be exactly the same type as Löbker's, yet Smith concluded that his was the result of a congenital malformation of the joint. From a study of the other cases in which defects occurred, one is led to the conclusion that they are usually small and unimportant, and that even when large enough to involve the posterior third of the head, they do not require resection. They are, probably, just as frequent, relatively, in those dislocations which never recur as in those in which the recurrences become habitual.

Tearing of the External Rotators of the Humerus. In my opinion, the only serious obstacle to the elucidation of the pathology of recurrent, anterior, shoulder dislocations is to be found in the work of Joessel, who reported the results of examination of nine specimens of this condition. Four of these were obtained from the bodies of three persons who were known to have had recurrent dislocations during life, one having had it on both sides of the body. The other five specimens were found in the dissecting room, during two winter sessions, from an examination of 200 cadavers, and of these five, it was not said that two occurred in one body. The inference to be drawn from this is, I would take it, that we may expect one recurrent luxation of the shoulder in about every forty persons, a percentage so high as to cast some doubt on the accuracy of Joessel's observations. Only four of these five dissecting room specimens are described with any detail. They are all said to answer in every essential to those which were taken from the bodies of the patients known to have recurrent luxations during life. In not one, however, was it shown that the luxation could be pro-

²² *Fractures and Dislocations*, 1847.

duced. In discussing Joessel's specimens I will confine myself to the latter, as they will serve every essential purpose. Reports of only four other authentic autopsy specimens were found in the literature, and one of these (Löbker) I have already excluded, for reasons given. The other three were reported by Perrier,²³ Broca, and Hartmann, and Sick. Joessel concluded from his study of his own specimens that the predisposition to recurrence of the anterior shoulder dislocations was due to the tearing of the supraspinatus and infraspinatus muscles with the underlying capsule from the humerus; but that it was also favored by the probably constantly occurring enlargement of the capsule. He held that when the supraspinatus and infraspinatus muscles tear away from the greater tuberosity, the head of the humerus will no longer be limited in its excursion to within the borders of the shallow and narrow glenoid cavity, so that from the contraction of the adductor muscles of the shoulder it is readily made to pass over the glenoid margin into the luxated position. He found a tearing of these muscles in every specimen, and also an enlargement of the capsule. In the first specimen the joint was filled with mercury, and found to contain 90 c.c. Normally, he says, the capsule contains only 28 c.c. With the supraspinatus and infraspinatus muscles the underlying capsule was assumed to have been torn from its humeral attachment, and the head of the humerus was said to have escaped through this tear. Perthes, while admitting the success of the operation, based upon the simple enlargement of the capsule, claimed a greater importance for the tearing away of the muscles inserted into the greater tuberosity. Much of his unusually elaborate paper is taken up by his efforts to support Joessel's position.

I appreciate fully the difficulty of disputing successfully Joessel's observations on his own specimens, especially after nearly thirty years of more or less generous and general approval by the profession. It is not, however, to what Joessel saw and described that I would take exception, but to his interpretation of his findings. It is not a simple matter to interpret the significance of the changes in such specimens long after the period of repair of a traumatic lesion. The chief point to decide is whether we have to deal with a tearing of the capsule from its posterior and superior humeral attachment, or a tearing of the capsule at its antero-inferior glenoid attachment, for the escape of the head into the anterior dislocated position. I believe that the pathology is a simple one, and that if this were recognized, most of these sufferers would accept operation and by it be permanently and almost, if not perfectly, cured.

The one sign of a tear in the capsule occurring in the original luxation, that could be detected years later, would be found in the

²³ Bull. et. mem. d. l. soc. d. chir. d. Par., 1878, iv, 112.

cicatricial tissue and adhesions existing in the immediate neighborhood of that tear. To distinguish by such changes between a tear at the anterior and inferior glenoid margin and one at the posterior and superior humeral attachment about two inches away is not without some difficulty. The only evidence of the tearing of the supraspinatus and infraspinatus muscle from the greater tuberosity, found in every specimen by Joessel, that he gives, depends chiefly upon statements to that effect; that is, he says that they were torn, the torn ends were retracted and attached to the capsule more posteriorly under the acromion. The illustration which he offers is diagrammatic and unsatisfactory, and does not increase the force of his description. Some of the specimens showed evidence, he says, of fatty degeneration, and in two at the sites of the insertions of the muscles into the greater tuberosity the bone was rough. In not one was a fragment of bone found in the retracted torn ends of the muscles. In every instance the capsule could be traced upward from its humeral attachment to the under surface of the acromion. It passed, he says, from its usual attachment about the greater tuberosity, but reached only the anterior border of the acromion. The under surface of the acromion formed a part of the upper wall of the joint. Close in front of the acromion was a protrusion of the capsule, intimately attached to the deeper part of the deltoid muscle, and separated from the rest of the capsule by a shallow groove. These statements are essentially common to all of the specimens. If they prove anything, it is that the cicatricial changes resulting from the healing in of the tear in the capsule corresponded in position to that of the upper part of a tear at the glenoid margin, and not to a tear at the greater tuberosity. Distances here are small, especially with reference to the location of the more or less diffuse adhesions of the capsule, but so far as they can be located from Joessel's description, they do not support his conclusion. The fact that he could not trace the capsule to the glenoid margin is strong evidence that the original tear was in this region. If the external rotators and the underlying capsule had torn from the greater tuberosity and the head had continued to escape through this gap at each recurrence, then the cicatrix with its associated adhesions to the overlying deltoid muscle should have been found at the greater tuberosity. Joessel shows clearly that they were not. Perthes says that no writer other than Joessel has observed that the acromion formed the upper part of the joint in this condition.

As for the atrophy and fatty degeneration of the supraspinatus and infraspinatus muscles, it is not easy to determine these changes in such small muscles. If one were satisfied as to their presence, he would still be unable to say that they were not due to the years of limitation of function occasioned by the fear of recurrence. Under these circumstances, these signs cannot be of much value in deciding the existence of an old tear in the muscles. The statements concern-

ing the retraction of the torn ends and their attachment to the capsule more posteriorly cannot so easily be disputed; yet, in my opinion, they are not convincing. The majority of writers, in describing their operations, speak of dividing the deltoid muscle or separating it from the pectoralis major to the capsule. They say nothing of the rotator muscles, the subscapularis, supraspinatus, infraspinatus, and teres minor, which cover the capsule almost entirely. A few did refer to them with more or less detail. The explanation for this failure to observe these muscles is probably to be found in

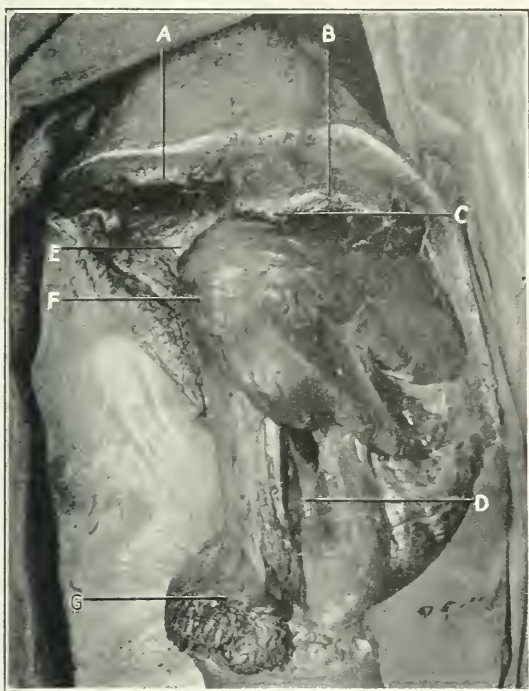


FIG. 3.—The left shoulder in normal position, with the arm at the side of the body (cadaver specimen). A, clavicle; B, spine of scapula; C, acromion process; D, triceps muscle; E, coracoid process; F, greater tuberosity, with the common tendon of the external rotator muscles inserting into it. The muscular portions can be seen terminating, some distance posterior to the tendinous insertion; G, lower cut end of the deltoid muscle.

the fact that at a variable distance from their insertions into the humerus, usually about an inch (Fig. 3), they end in thin, flat tendons, which spread out and fuse with one another. This is particularly true of those which insert into the greater tuberosity, the supraspinatus, infraspinatus, and teres minor. In this tendinous portion they are intimately blended with the capsule underneath, look very much like capsule, and could here be easily mistaken for it, with a limited exposure in a small wound. The muscular bellies end some distance posterior to the humeral attachment. To ex-

amine the capsule, Joessel dissected these muscles from their scapular attachments outward. It is easily conceivable that he concluded that the anterior attachments to the capsule, normally some distance posterior to their humeral insertions, were the retracted torn ends of the muscles. His illustration, in my opinion, rather indicates a normal condition than a tear of the tendons. In none of the other three recorded autopsy specimens was such a tearing of these muscles found. Perrier's specimen was recorded in a paper which appeared two years before Joessel's paper, and made no reference to such a lesion. In Sick's specimen, the supraspinatus, infraspinatus, and teres minor muscles were said to be attached to the humerus in their normal places and were not atrophied; while Broca and Hartmann said that they did not accept Joessel's conclusion on this point, because their specimen did not show such a tearing of the muscles.

Pertthes, who is the most recent writer to support strongly Joessel's findings, found a tearing of these muscles in two cases operated on—a tearing of the capsule from the anterior glenoid margin in one, and an enlargement of the capsule in a fourth operation. Of the first two, he said that there was no adhesion of the capsule to the deltoid in the region of the greater tuberosity. The blunt separation of the deltoid from the capsule was easily carried out. The head of the humerus, he says, covered by capsule and muscles, was easily exposed and showed nothing abnormal. A cicatrix here would not have permitted such an easy exposure. It was only after opening the joint and palpating its inner surface with the finger that he found the evidence upon which he based his statement that the supraspinatus and infraspinatus muscles were torn from the greater tuberosity. This evidence consisted of a rough area of bone, bared of cartilage, about the size of a mark, in the position of the greater tuberosity. He says that, more than that, a part of the capsule could be lifted from the humerus by the finger in the joint space. Defects of the cartilage in immediate proximity to the greater tuberosity have been demonstrated by the recorded autopsy and resection specimens, but in all of them it was evident that the tuberosity itself was not involved; so that they could not be due to the tearing away of the muscles inserted into the tuberosity. They were probably due to the striking of the posterior surface of the head against the anterior glenoid margin in the luxated position. The lifting of the joint capsule from the humerus by the finger in the joint space has no significance, as this can be done normally. Although Pertthes implied that the separation from the bone could be carried farther downward than normal, there is nothing else in his report to prove it, and any statement so indefinite should not be accepted as proof. While I would not deny the possibility of such a tearing of these muscles in recurrent dislocations of the shoulder, the evidence of it which I have found in the literature is far from convincing.

Joessel makes the statement that "the upper capsular tear was abundantly large enough to allow the head to escape and to take its place under the coracoid process." In this I see the strongest evidence in Joessel's whole paper, that his interpretation of his specimens was basically wrong. He says that in every one of them the tear of the muscles involved only the supraspinatus and infraspinatus muscles, the corresponding portion of the underlying capsule being torn also. Through such an opening it is impossible for the head to escape, as anyone may see by making it on the cadaver, by knife or scissors. It should be borne in mind, in estimating the value of Perthes' support of Joessel's position, that the latter found this tear in every one of his specimens, and implied that it was to be expected in every recurrent luxation—that it was the essential lesion. Perthes found it in only two of his four cases. His two others, he says, represented two other groups of cases—those due to tearing of the capsule from the anterior glenoid margin and those due to enlargement of the capsule. As already stated, I regard these two as one and the same, the enlargement of the capsule resulting from a capsule tear usually at the anterior edge of the glenoid fossa. It may tear from its humeral attachment in a recent luxation sufficiently to permit the head to escape, as the capsule of the hip may tear from its femoral attachment (Allis). Such a case would probably never result in a recurrent luxation, because in the reduction, as Allis has shown in the case of the hip, the torn capsule would be pushed by the head into the glenoid cavity, and would then intervene between the head and the glenoid fossa, making the reduction incomplete and probably inducing a limitation of motion that would prevent future luxations.

If, as Joessel maintained, the supraspinatus, infraspinatus, and teres minor muscles so limit the excursion of the head of the humerus to within the borders of the glenoid cavity that the latter cannot be overstepped, then it would be impossible to dislocate the head into the complete subcoracoid position on the cadaver without tearing these muscles. Yet I have often done this and have never seen the muscles torn (Fig. 4). Joessel must have had some experience with experimental luxations, for he says that the external rotator muscles are not torn in them. He does not attempt to explain away this argument against his conclusions. The one cadaver specimen, in which, as already stated, the greater tuberosity was torn off, merely shows that the head had been pushed farther forward than was necessary for the production of the luxation, and the fact that this fracture has been shown to have occurred in recent luxations, does not prove that it is necessary for a recurrence. I have not found that an autopsy or operation has ever shown it to have occurred in a recurrent luxation, and there is reason to believe that a fracture here will prevent the development of recurrences. It would, in all probability, induce considerable pain on

movement in the shoulder for some weeks after the accident, so that the patient would be compelled to keep the arm at the side of the body long enough to permit complete and close healing of the tear in the capsule, when recurrences from the usual slight force would not take place. Stimson says: "Clinically it is known that after a few days or weeks marked by gradually diminishing tenderness and swelling, the joint can be freely used without pain." It is obvious that when the joint can be freely used in a few days without pain, there is no fracture. My patient experienced his

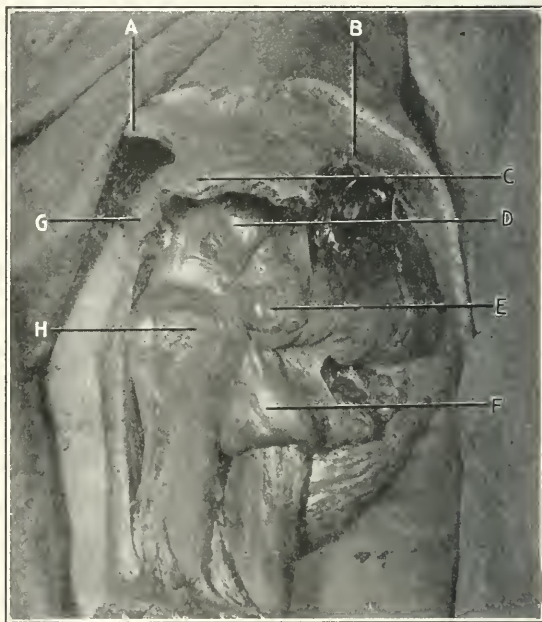


FIG. 4.—Postero-external view of the left shoulder, with complete subcoracoid dislocation. The external rotators not torn and are not under severe tension. *A*, clavicle; *B*, spine of scapula; *C*, acromion process; *D*, supraspinatus muscle; *E*, infraspinatus, *F*, teres minor; *G*, coracoid process; *H*, greater tuberosity.

first luxation in a football game. He did not confine the arm with a bandage, and five days later played in a similar game, when he had his second luxation. This fact would argue against a fracture in his case.

Neither Joessel nor any other surgeon, so far as I have been able to learn, has claimed that the tear in the capsule necessary for a recurrent luxation differs from that necessary for a recent, although Stimson seems to imply it. Joessel, because he believed that a tear of the supraspinatus and infraspinatus and the underlying capsule was necessary for every anterior luxation of the shoulder, advised that in the treatment of the first luxation the arm should be

kept in the horizontal position in order to approximate the margins of the muscle and capsule tear, and to obtain close union during the period of repair. This would be logical if his pathology were right. There are few physicians today who would not advise that the arm be kept at the side of the body, that is, in adduction, during the healing period; and everyone who does employ this treatment rejects Joessel's findings in his specimens of recurrent anterior luxations of the shoulder. The following, from his book on fractures and dislocations (1907), would indicate that Stimson still accepts Joessel's teaching: "This tendency (to habitual dislocation) has generally been attributed, although without anatomical proof, to laxity of the capsule, itself the consequence of imperfect repair of the rent made in it at the time of the dislocation; but the recent researches of Joessel show, for the forward dislocation, that the enlargement of the capsule observed in such cases sometimes takes place at the upper portion in consequence of the rupture of the capsule at the same level and the creation of a free communication between its cavity and that of the subcoracoid (subacromial) bursa." Stimson, however, says of recent subcoracoid dislocations of the shoulder that the capsule is torn at the lower and inner portion. According to Joessel, the tear is in the upper and outer portion. Stimson dresses the arm at the side of the body with inward rotation, to approximate the margins of the rent during the period of repair. Joessel, as we have seen, advises abduction of the arm at the shoulder to obtain the same result. That Stimson really does not accept Joessel's pathology of recurrent dislocation of the shoulder is shown best by the fact that in two cases he followed the Ricard principle, of only shortening the capsule anteriorly, with good results, and recommends this operation as the best.

While most of the surgeons who, in recording cases, have taken up the pathology of this subject, have given more or less credit to Joessel's findings, I have found only two who have applied the principle involved, in their operations. Francke, in one of his four cases, excised an oval piece at the site of what he regarded a muscle tear (supraspinatus and infraspinatus), and brought the edges together, thus shortening the capsule and bringing the torn edges of the muscles nearer to their normal insertions. There was no recurrence four months later. No later observation was reported and no reference to function, so that we cannot fairly compare this case with any of those in which the anterior relaxed portion of the capsule was shortened without suture of the muscles. Perthes, in two of his cases, brought what he supposed were the torn ends of the same muscles as far forward as possible toward their normal insertions. He drove iron staples into the humerus, toward which he drew the muscle ends. He likewise shortened the relaxed capsule by reef sutures of silk. It was, in all probability, this feature of the operation which produced the good results, and they were

surely not better than those obtained from simply shortening the capsule. In his first case, two years after the operation, and in his second case, three months after operation, the affected arm could be raised vertically to an angle of 160 degrees. My patient, three months after operation, could elevate the arm straight upward, or to an angle of 180 degrees. Probably all that was accomplished by suturing the muscles was to shorten them slightly and thus to impair their function. Probably, and fortunately, the sutures cut through, and the new adhesions were broken up by the active and passive movements of the after-treatment in the weeks following the operation, so that the effect of the sutures was largely overcome. When a partial dilatation of the capsule was noted, it was practically always of the anterior, internal, or axillary portion, and is readily explained by an original tear of that portion.

As a result of my study of the subject, I am led to the simple conclusion that the usual anterior, habitual, or recurrent dislocation of the shoulder is due to a traumatic, cicatricial, anterior, hernial pouch of the capsule, and that the object of the operation should be to obliterate the hernial protrusion. It would be a simple matter to remove at the same time any free or attached joint body that may be present. Joessel's teaching is based upon a misinterpretation of his specimens, and should be set aside.

The treatment of this condition will be taken up in a subsequent paper.

THE CLINICAL FORMS OF PYELONEPHRITIS.¹

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It is difficult to find a correct name for the condition to be described in this paper. The term pyelonephritis is, without doubt, the proper one from a pathological standpoint for those cases which I shall speak of as the urogenous type, that is, those in which the infection extends upward from the bladder to the pelvis of the kidney. In the other variety, that is, the hematogenous type, in which the infection is carried to the kidney through the blood stream, the pelvis of the kidney is but little affected until late in the disease, so that the pathologist would term these cases septic nephritis. The clinical picture, however, of both types is so similar that it seems best for the present to retain the term pyelonephritis

¹ Read at a meeting of the Mississippi Valley Medical Association, October 14, 1908.

to include both modes of infection. Henry Morris² calls the condition to be described "acute interstitial nephritis," but this, and the term "infective nephritis," lead to so much confusion with well recognized clinical forms of nephritis that it is well to discontinue their use in this connection.

Pyelitis and pyonephrosis have been well recognized conditions for many years. The intermediate pathological condition, pyelonephritis, in which the kidney is the seat of suppuration in its earlier stages, has not received the consideration which it deserves. It has become an absolute necessity at the present time for us to be able to recognize such a pyelonephritis clinically in order to be able to treat it properly.

ETIOLOGY. The causes are most conveniently divided according to the chief modes of entry of the infection: the urogenous or ascending, and the hematogenous or descending.

1. *Urogenous Type.* (a) Cystitis is one of the most frequent sources of infection. The presence of cystitis alone would not be sufficient to explain the spread of infection along the ureter to the kidney. We know that normally the back flow of urine from the bladder into the ureter is prevented by a number of factors, chief among which is the sphincteric closure of the ureter. Israel and others have shown that in cases of enlarged prostate and stricture of the urethra, there is a diminished action of this sphincter, and the orifice becomes patulous, thus allowing the urine to back up into the ureter. Any condition, such as cystitis, which increases the normal intravesical pressure, will produce the same effect. Again, a loss of contractile power on the part of the bladder walls, such as occurs after enlarged prostate or injuries and diseases of the spinal cord, will produce the same result. (b) Any obstruction to the outflow of urine from the kidney, whether it be in the pelvis of the kidney, ureter, bladder, or urethra, may be a factor. This urogenous cause includes calculi, strictures, tumors pressing upon the ureter, enlarged prostate, and kinks of the ureter in floating kidney. (c) *Fistulæ* between the ureter and other hollow viscera, such as the rectum, which will permit of the entrance of organisms into the ureter, may also serve as a cause.

2. *Hematogenous Type.* (a) *Primary.* This includes the cases in which the foci of infection in one or both kidneys are the only demonstrable ones. This is the form to which attention has of recent years been directed by Brewer, Cabot, and others. In some of the cases the condition has followed a trauma, and Brewer has demonstrated experimentally that an injury favors localization of the organisms; but so many cases occur without an injury that the latter cannot be regarded as a vital factor. (b) *Secondary.* This embraces a large class of cases in which the renal infection is preceded,

² Surgical Diseases of the Kidney.

(1) by one of the acute infectious diseases, such as pneumonia, typhoid fever, erysipelas, or diphtheria, etc.; (2) by a focus of suppuration elsewhere in the body, such as a furuncle, carbuncle, phlegmon, osteomyelitis, etc.; or (3) by some form of bowel infection. The latter is the most frequent source of infection in the cases of pyelonephritis in children, as shown by Heubner, Baginsky, and Abt.

PATHOLOGY. The organisms most frequently found in both the urogenous and the hematogenous types are colon bacilli, staphylococci, streptococci, gonococci, and proteus vulgaris. It is generally believed that the gonococcus simply prepares the soil for the other varieties by producing a preceding cystitis, ureteritis, or pyelitis.

The colon bacillus and the ordinary pus organisms undoubtedly play the chief role in the majority of cases, whether of hematogenous or urogenous origin. The pathological changes vary according to the source of infection and the virulence of the organism. In the urogenous or ascending type the changes characteristic of an acute or chronic pyelitis precede the renal changes. The latter differ from those found in the hematogenous type by the fact that the first evidence of infection of the renal parenchyma in the urogenous type is in the form of yellowish streaks, extending from the papillæ into the medulla and cortex. In addition, one finds multiple miliary abscesses scattered through the cortex. A characteristic feature of these pyelonephritic abscesses is their frequent arrangement in groups, surrounded by zones of intense hyperemia, best seen on the surface of the kidney. Each miliary abscess is surrounded by a dark zone of intense hyperemia. Whether the abscesses occur singly or in groups, they usually project beyond the level of the surrounding cortex and become adherent to the capsule. If there is much obstruction in the pelvis, ureter, bladder, or urethra, the back pressure greatly favors the destruction of the kidney, and all stages of the process can be found from the small abscesses to transformation of the kidney into a pus sac (pyonephrosis).

The hematogenous form differs somewhat in its pathology from the urogenous. There are no preceding changes in the pelvis of the kidney, especially no yellowish streaks of purulent softening radiating from the papillæ toward the cortex. The hematogenous type may appear in such a hyperacute form that only congestion and turbidity of the kidney parenchyma are found, death taking place in a few hours after the onset of symptoms. In the less acute form the changes are somewhat similar to those found in the urogenous type. Throughout the parenchyma, numerous foci of infection are found. These show all of the stages of suppuration from leukocytic infiltration to necrosis of the tissues and pus formation. As in the urogenous type, the most characteristic evidence of infection is the presence of a large number of miliary abscesses on the surface of the kidney. There is, however, not as much tendency to the group-

ing of the abscesses as in the urogenous type. In some of the hematogenous cases a single or several large abscesses have been found, instead of numerous small ones. Goodhart, in 1868, and Weir, in 1894, showed that the urogenous type very frequently involved only one kidney. Prior to that time the old term "surgical kidney" was usually interpreted as a bilateral infection of both kidneys following a cystitis, enlarged prostate, calculi, etc. Attention has of recent years been directed to the fact that in many of the cases of hematogenous infection the disease is quite often unilateral. This latter fact is very important in the diagnosis and treatment of the condition.

SYMPTOMS AND DIAGNOSIS. There is scarcely any other renal disease which presents such a variety of clinical pictures as pyelonephritis. A description of one group of symptoms would not answer for every case. It is, therefore, most convenient to divide the clinical forms of pyelonephritis, first, according to the source of infection, that is, whether it has reached the kidney through the blood stream (hematogenous) or through the medium of the ureter (urogenous). This division will suffice for quite a number of cases in which the previous history and the examination of the urine will show whether or not the bladder has been the source of infection. There are, however, an equally large number of cases in which the source of infection is not quite clear, and yet the clinical picture of a renal infection is quite evident. It is so difficult to classify the latter class of cases that it has always seemed advisable to me to place them in separate groups. The cases to which I refer are those occurring (a) in children, and (b) in the puerperium and during pregnancy. Clinically, then, such a division would be as follows:

1. Hematogenous type: (a) Hyperacute; (b) acute; (c) subacute.
2. Urogenous type: (a) Recurrent febrile; (b) continuous febrile (chronic urosepsis).
3. Pyelonephritis of children.
4. Pyelonephritis of pregnancy.
5. Pyelonephritis of the puerperium.

1. **HEMATOGENOUS CLINICAL VARIETIES.** For many years the view was universally held that renal infections (not including calculous pyonephrosis or renal tuberculosis) were almost always bilateral and the result of a preceding cystitis. For this reason the now obsolete term of "surgical kidney" was employed to include every clinical variety of the disease. We now know that the source of infection can be recognized from the symptoms and examination alone as being hematogenous in origin, and that in a very large proportion of cases the infection involves only one kidney, and is thus amenable to surgical intervention. Israel³ was one of the first to call attention to hematogenous renal infection as a clinical entity.

³ Surgery of the Kidney, 1901.

Since that time George E. Brewer, Farrar Cobb, I, and others have described the clinical picture of these cases of acute hematogenous infections of the kidney. The clinical types of the latter are:

(a) *The Hyperacute Hematogenous Form.* The clinical course is usually so rapid and the symptoms of a most virulent infection so marked that any symptoms pointing to the kidney as the source of infection are obscured by the general sepsis. The onset of symptoms is very sudden, usually in persons who have previously enjoyed good health. There is great prostration, high fever (to 106° F.), rapid pulse, marked leukocytosis, vomiting, and often general muscular pains. In some cases there is severe abdominal pain, muscular rigidity, and tenderness over the costovertebral angle. When localizing symptoms such as those just mentioned are absent, and the examination of the urine is negative, the diagnosis must be one of exclusion. The conditions which must be considered in the differential diagnosis are severe influenza, acute abdominal affections, such as perforation of gastric and duodenal ulcers, appendicitis, gallstones, mixed infection in tuberculous kidneys, malaria, and typhoid fever. Unless the appendix lies behind the cecum, or high up near the liver, the differentiation from appendicitis is not difficult. In the latter disease there is more muscular rigidity and tenderness, and pain is a far more prominent symptom. In the case of the retrocecal appendix there is tenderness and pain in the iliocostal space, but there is apt to be more muscular rigidity and spontaneous pain than in acute renal infection. In many cases examination of the urine will be of great aid in distinguishing the two conditions.

In acute cholecystitis the pain is more superficial and nearer the costal arch. Muscular rigidity is most marked in the right hypochondrium, and tenderness on palpation more marked there than in the iliocostal angle. The differentiation of the other conditions named usually presents no difficulties.

(b) *Acute or Intermediary Hematogenous Form* (Brewer). The clinical pictures in the less acute or intermediary (Brewer) hematogenous forms of infection differ but little from that of the acute urogenous type. The chief difference lies in the fact that the symptoms in the hematogenous type begin either after one of the acute infectious diseases or soon after a septic focus, such as a carbuncle, etc., has appeared in some other part of the body. In the urogenous form there is often the history of a preceding cystitis, or there are evidences of the presence of obstruction in the urinary tract, either in the form of a valve, stricture, or stone in the ureter, or of an enlarged prostate, or calculi obstructing the urethra.

In these acute cases there is the history of a sudden onset of fever, often accompanied by chills. The temperature is irregular and often persistently high, and is accompanied by all the other evidences of a severe infection. Fortunately, the localizing signs both in the acute and subacute forms are more marked than in the hyper-

acute. There is usually some tenderness over the iliocostal angle, and often muscular rigidity here.

(c) *Subacute Hematogenous Form*. In this third form of hematogenous renal infection the principal symptoms are long-continued fever of an irregular character, accompanied by unilateral costo-vertebral tenderness. Urinary findings are more constant in acute and very mild forms than in the hyperacute. Pus, blood, casts, and albumin are present in the majority of cases. The diagnosis in this mild class is made by a thorough examination so as to exclude any other source of fever taken in conjunction with the costovertebral tenderness and urinary changes.

2. *UROGENOUS CLINICAL VARIETIES: (a) Recurrent Febrile Urogenous Type*. The symptoms of this form are quite similar to those of the hematogenous subacute form just described. The history differs somewhat: As in the acute hematogenous form, a patient who has had a cystitis will suddenly have one or more chills, followed by high temperature and profuse sweats. This syndrome will last several days to a week, and then the temperature will become normal or slightly above normal for a variable period. A second attack of chills, fever, and sweats will occur as unexpectedly as the first, and the same cycle will repeat itself a number of times.

The diagnosis in these cases presents no difficulties if one will examine the urine for pus, blood, and casts, which are almost invariably found. The amount of pus is always larger just after the cycle just described, since it is the retention of this pus in the kidney which causes the recurrent febrile attacks.

(b) *Chronic Urogenous Pyelonephritis*. In this group of cases the renal infection is always secondary to a cystitis. The latter may be a complication of a hypertrophied prostate or a stricture of the urethra. Such mechanical obstructions to the outflow of urine are not a necessary factor in the production of a cystitis which is followed by chronic infection. Cystitis may exist in both sexes, but with especial frequency in the female, without such mechanical obstruction, and remain unimproved for months and years. In this class of chronic urogenous renal infections the clinical picture is often that of a pyelitis alone. Pathologically, however, the renal parenchyma is equally as much involved. Clinically these cases present a most varied picture. In some, fever is more or less constant. The temperature ranges from 99° to 100°, rarely higher. There is an inability to gain in weight in spite of the most careful attention to diet and general hygiene. Such patients lack color, and in some the anemia is quite noticeable. A dull aching pain in the lumbar region is quite often present. The urine contains pus in variable quantities.

An effort was made by older writers to distinguish pus coming from the kidney from that due to a cystitis by the fact that in the former case (kidney) the urine was acid and epithelial cells with

small bodies and long tails were present in the urine. These epithelial cells were said to be characteristic of the renal pelvis. In cystitis, the urine was said to be alkaline, and there was an absence of the aforementioned epithelial cells. We now know that these older views as to the source of the pyuria, although true in a measure, cannot be relied upon to distinguish pus of vesical from that of renal origin. The reaction of the urine depends upon the microörganism which causes the infection. If it is due to the colon bacillus alone, as is so frequently the case, the urine is acid, whether the bladder alone or both it and the kidney are involved. If the infection is due to the urea decomposing organisms, the reaction is alkaline. In regard to the epithelium, it is a well-recognized fact that metaplasia or change in form occurs so frequently in the bladder epithelium during a cystitis that no reliance can be placed upon any particular form as distinguishing bladder epithelium from that coming from the renal pelvis. The only positive manner in which the source of a pyuria can be determined is by a careful study of the clinical symptoms taken in conjunction with the results obtained by cystoscopic examination and ureteral catheterization.

In many of these chronic urogenous pyelonephritides there are periods in which they have higher fever and other more general signs of infection, which rapidly subside as soon as the drainage from the kidney is free again. Influenza, malaria, intestinal auto-intoxication, rheumatism, etc., are often diagnosticated in these cases, when in reality the source of the recurrent or protracted fever, etc., is in the kidney.

3. PYELONEPHRITIS DURING INFANCY AND CHILDHOOD. This form only differs from those just described by the fact that it is a frequent cause of obscure fever in infants and young children, and as such deserves special mention. In a recent paper I. A. Abt has reported 22 cases of cystopyelitis, and calls attention to the presence of persistent fever in children, accompanied by rapid pulse and progressive pallor and emaciation. The fever is frequently interpreted as due to an intestinal intoxication, and unless pyelonephritis is borne in mind as one of the causes of obscure fever during early life, the diagnosis will either not be made at all or the condition will be recognized too late to be of any benefit. The mode of infection in the majority of these cases is undoubtedly through the blood stream, and the source or atrium for the organisms to enter the circulation is in the intestine. The acute febrile form with the clinical picture of a severe sepsis ushered in by chills, high fever, etc., does not occur nearly as often in children as in adults. An examination of the urine should be made in every case of continued or remittent fever in children when no other cause can be found.

4. PYELONEPHRITIS DURING PREGNANCY. The symptoms of renal infection occurring during pregnancy differ but little from the

description of the clinical picture in males and in the non-pregnant female. The only reason for describing it separately here is to call attention to the fact that when it does occur during pregnancy the possibility of renal infection is seldom taken into consideration in making a diagnosis of the cause of either a continuous fever or of chills and fever, which occur without warning.

A recent case of mine will serve to illustrate many of the important points: During the fifth month of her pregnancy, a patient who had previously enjoyed the best of health had a chill, followed by a temperature of 105° F., accompanied by rapid pulse, great prostration, high leukocyte count, and scanty urine containing much pus. The temperature dropped to normal within a few hours, but the same cycle of chill, fever, and sweat recurred at irregular intervals during the following four days. The urine contained a few casts and some epithelial cells, which were interpreted as of renal origin. There was not more albumin than could be accounted for by the amount of pus present. I saw the patient in consultation on the fourth day of the illness. Palpation of the abdomen failed to show any localized muscular rigidity or tenderness over the right iliac region. One could make deep pressure over all parts of the abdomen, but there was no sensitiveness except upon bimanual palpation of the right kidney, and here it was only of moderate degree. Examination of the genitalia was negative. One could thus exclude appendicitis, cholecystitis, or any form of genital infection. The possibility of such a sudden onset, during pregnancy, of chills, fever, etc., even without vesical symptoms, was recalled, and after appropriate non-operative measures were instituted, the patient made a prompt recovery. Pregnancy proceeded without further incident and ended in a normal manner.

This case illustrates one of the two clinical pictures under which renal infections can occur both during pregnancy and in the puerperium. In the second form, the disease may pursue a more chronic course. There is a general feeling of malaise, accompanied by muscular pains, fatigue, and fever of varying degree. It is the persistence of this temperature which first directs attention to this second class of cases. Bladder symptoms, as in the more acute form, may be entirely absent or very slight. In the chronic form the presence of pus in the urine is a more constant finding than in the acute form, because the infection is usually the result of the ascending type, that is, from the bladder. Tenderness over the kidney or ureter is seldom sufficiently marked in these more protracted cases to be of value in making a diagnosis. When the outflow of pus from the kidney is not obstructed there is but little fever, but this recurs promptly when there is any retention. The use of the cystoscope is seldom necessary, since the diagnosis in both of the above classes of cases can be made by excluding any other source for the fever than the kidney.

In the majority of cases the pyelonephritis is upon the right side. This is due to the fact that although both ureters are compressed by the uterus during pregnancy, the right ureter is more compressed than the left, as the result of the rotation of the uterus on its long axis from left to right and the greater frequency of positions in the right oblique diameter. The most frequent abdominal conditions which begin so acutely are cholecystitis, stones in the common bile duct, and appendicitis. These can be readily excluded by the absence of localized muscular rigidity and tenderness over the respective areas, and the fact that high fever preceded by chills is only characteristic of common duct stones.

5. PYELONEPHRITIS IN THE PUERPERIUM. This, like the similar condition in pregnancy, may begin very suddenly, without prodromal symptoms like those of cystitis. In the majority of cases the source of the infection in all probability is in the bladder. In only a small number is the infection a descending (that is, a hematogenous) one. The patient may have made an excellent recovery from the parturition with normal temperature, pulse, and lochia. Then suddenly she has a chill, followed by high fever, rapid pulse, and a marked leukocytosis. The fever either persists or recurs irregularly following a chill.

In some cases there is marked pain over the affected kidney (in the lumbar region) and along the ureter. In others there are absolutely no localizing symptoms referable to the kidney. This syndrome may occur during the first few days or several weeks after parturition has occurred. Pus in a variable quantity is usually present in the urine; and in some cases there is vesical tenesmus and pain on micturition, but these two symptoms are not constant. The diagnosis in these cases must be made by excluding any of the pelvic complications following infection during or soon after parturition. If the pelvic examination yields negative results, an infection of the kidney should always be thought of as a frequent cause of fever during the puerperium. The clinical picture just described, of a sudden onset with chill, fever, etc., does not fit all cases. In some, the only symptom to attract the physician's attention is rise in temperature, especially toward evening, for which no cause can be found in the genitalia. Palpation of the kidney in both of the above types often reveals considerable tenderness, especially on bimanual palpation. The organism which causes the pyelonephritis is the colon bacillus, and the starting point is without doubt an intestinal infection, especially in those cases in which any instrumental infection of the bladder can be excluded.

THE OPERATIVE TREATMENT OF DEFLECTION OF THE NASAL SEPTUM.

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THE consideration of the proper operative treatment for the restoration of the deflected nasal septum is only secondary in importance to that still important question as to the justification of the operation in any individual case presenting itself for consideration. Since attention was first called to the deflection of the septum, and the possible influence that bending of the septum—obstructing one or both of the nasal chambers more or less completely—may play in the causation of certain pathological changes in the nasal cavities, the ingenuity of rhinologists has been taxed to overcome this deflection with the restoration of the septum to a normal vertical plane.

The nasal septum is a thin plate of cartilage and bone covered with mucoperichondrium and mucoperiosteum, and separates the nose into two nasal cavities. The mucoperichondrium and mucoperiosteum are very loosely attached to the bone and periosteum, except at sutural borders and where from traumatism it has formed adhesion. This structure is composed of the quadrangular cartilage, the vomer, and the perpendicular plate of the ethmoid. It should be placed in a vertical plane in the nose to be in an absolutely normal position. Through the action of various agents the septum becomes subject to alteration from the normal plane; when this change is so excessive as to obstruct one or both nasal cavities, or bring it into contact, more or less constant, with one or more of the turbinates, the condition becomes pathological. The changes in the septum may be such that there is a simple bending of the septum without any thickening; at other times the deflection is attended with increase in its later dimensions, which latter may assume the form of thickening at the point of greatest bending or the formation of a distinct ridge or spur.

ETIOLOGY. The etiological factors which produce deviation of the septum may be classified under four headings: Developmental, obstructive, traumatic, and diseases of a general or local nature.

Developmental. This factor no doubt plays quite an important role in the causation of deflection of the septum. The septal constituent parts not ossifying with equal degree of rapidity, and being in excess of the normal space allotted to them, cause, naturally, a bending of the later ossifying bone or the least resisting constituent of the group making up the septum.

Obstructive. Conditions causing obstruction to the air current through the nasal cavities impair the development of these chambers

and the constituent bones that enter into their formation. At the same time there is frequently an increase in the arch of the hard palate, leaving, consequently, less vertical space in the nose within which the septum must form.

Traumatic. Direct violence of great force is frequently sufficient to fracture the bones of the septum, causing displacement of them with resulting deflection; or by separating the quadrangular cartilage from its attachment to the vomer and ethmoid it causes luxation of the latter, with resulting deflection of the structure. Mild blows, frequently repeated, received throughout childhood, cause occasionally displacement, but most frequently thickening along the sutural borders.

Diseases of a General or Local Nature. It is stated that syphilis and rachitis are factors in developing deflections, but wherein they can be causative agents I have never been able to see. Local inflammatory disturbances producing adhesions in the young and newgrowths are infrequent causative agents.

SYMPTOMS. A deflected septum in itself is not a pathological condition. The deflection becomes pathological only when it causes impairment of the function of the nose either through partial or complete arrest of the air current through one or both of the nasal cavities, or when through pressure upon the turbinate bodies, intermittent or continuous, the cause interferes with the performance of the normal functions of these bodies; or, when through one or both of these disturbing causes, a certain train of symptoms is produced which are usually designated as reflex.

It is not always possible to come to an immediate conclusion wherein and how far a deflected septum is giving rise to symptoms. The compensatory function of all organs of the body is so great that often gross pathological lesions apparently cause no marked alteration of function. This compensatory function in the nose is well marked, so that oftentimes marked deflection causing complete obstruction of one nasal chamber apparently gives rise to no inconvenience to the patient. At other times, when the objective evidence is not very pronounced, most frequently when the whole plane of the septum is bent toward one cavity, narrowing but not markedly obstructing the affected side, the disturbance to nasal breathing and the general health of the patient is very marked. At times it is very simple to observe the necessity for operative intervention. The obstruction is patent and the subject evidence, as described by the patient, is positive. Those cases with moderate deflections and marked vasomotor disturbances also tax the skill of the diagnostician, as regards the relation of cause and effect. Oftentimes it becomes necessary to examine a patient several times, at intervals, under different conditions, to come to a safe and sure opinion. Indeed, at times, when a septum has been operated upon after one had somewhat

of a struggle to come to the operative opinion, one will find, well back beyond the deflection, prominent ridges or spurs, which projected into the turbinate, and which were entirely hid from view by the deflected portion of the septum. At the present day, when operative intervention about the septum has become so common, it is well that one consider the case quite thoroughly as to the extent of the deflection, as to its impairment of respiration, how far it influences pathological changes within the nasal cavity, and to what extent the reflex symptoms present in the individual case can be associated with the deflected septum.

The only condition which may stimulate a deflected septum and would possibly deceive one who is competent and skilful enough to perform this operation is a gumma of the septum. I recently saw a gumma involving the cartilaginous septum in the upper two-thirds of its extent on one side, which had been brought to me for operation. On the deflected side there were the evidences of deflection, as shown by the rounded gumma; on the other corresponding side of the septum there was a flat, plane surface. An indefinite history of syphilis was obtained. Three months later I saw this patient with a perfectly flat septum on both sides.

TREATMENT. In the early period of nasal surgery it was recognized that the deflected septum played an important role in the impairment of function and the causation of certain pathological changes, so that rhinologists early sought methods to overcome this condition. The early attempts at correction were vain, and more failures by far were the result of operative treatment than improvements—very few good results. Various forms of penetrating punches, as well as stellated cutting forceps, were used at that time, with solid metallic or ivory splints to retain the so-called straightened septum. Then came the operation of Roberts, the cutting of the septum and pinning the septum into its new position. We next find the varying types of cutting and crushing operation, which had for their purpose the destruction of the resiliency of the septum, thus restoring it to the vertical plane, where it was retained by splints in its new position until the attempt had proved a success or failure. The cases that resulted favorably through this method of operation were those that permitted the riding over of the fractured fragments. The redundant septum thereby reduced itself so that it could more nearly approach the normal type. Under this class would be included the Asch, Roe, and other operations too numerous to mention.

The operations for deflection of the septum, done under the plan suggested by Asch and Roe, yielded often excellent results in the hands of the projectors of these operations; nevertheless, in the hands of others who essayed this form of operation, failures and untoward results were as frequent as successes. It has been my experience to re-operate upon a number of cases subjected to this

form of operation, in which nothing seemed to have been gained by the former operative procedure. Later came special modifications of these operations, all being an improvement on the previous more or less blind, crushing method, and each, in certain types of deflection, being attended with most excellent results. Under such groupings may be classified the Kyle, Watson, Gibbs, and others following out the same general technique. All the above-mentioned operations have in common the cutting, or cutting, sawing, and fracturing of the displaced septum, thus removing redundant tissue or permitting the over-riding of the fragments and reducing thereby the redundancy of tissue, and leaving, after healing, a replaced, firm septum in its normal anatomical integrity.

During the greater portion of this period there had been gradually developing a type of operation which had for its purpose the removal of the deflected portions of the septum, whether cartilaginous or osseous, or both, through a submucous method, leaving a straight, although a partially flaccid septum. Through the efforts of Myles, Killian, Hajek, Freer, and others, this method has been perfected in the last five years, and, as perfected, has been accepted by the greater portion of the rhinological world as the operation for the correction of misplaced septa. Those operators who had gained the greater portion of success in their operative cases through the employment of one or more of the previously designated operations were rather loath to accord fellowship to the new—to them untried—method of operating.

The objections raised against the new operation were: (a) The possibility of lowering the plane of the dorsum of the nose; (b) the great possibility of causing perforations through the new method of operating; (c) the question as to the advisability of replacing a normal osseocartilaginous septum with a semiflaccid septum; and (d) the recognized difficulty of the technique, and the time consumed in the operation. Previous to 1904 I had done all my operative work upon the septum by a method that had given me a more than fair degree of successful issue. For several years failure in operative treatment, with restoration of the septum to a normal or nearly normal plane, was rather infrequent by my method. I was, therefore, uncertain as to the advisability of relinquishing my previous method for the new doubtful one. My operative procedure had for its purpose the removal of a narrow, linear wedge-shaped segment of bone from the osseous septum at the juncture of the vomer with the floor of the nose, through the use of a Fetterolf saw; the separation through sawing, or partially sawing, and then fracturing the nasal spine; cutting through the whole anterior border of the quadrangular cartilage just behind the columna, continuing this incision along the superior border to the degree necessary; the operation being completed by fracturing the anterior extremities of the vomer and ethmoid, when found necessary.

Always after this method of procedure the septum would fall into a normal vertical plane.

The test of the probable success of any of these forms of operative procedure is the fact that the septum will assume the normal vertical plane after the operation is done—retaining apparatus only being necessary to prevent displacement. In this operation, as well as all other operations done upon the septum, the individual case and its requirements should be the controlling factor which should govern the operation, that is, as to the character of the incision, the length of the incision, the amount of bone to be excised, and other details; one detail, however, should never be forgotten, and that is, sawing through and loosening the nasal spine. The retaining apparatus employed in my cases is the Kyle aluminum splint, which is worn continuously for about seven days. This operative procedure presents certain features that were original creations of mine. The fracture of the spine had been suggested and acted upon by Harrison Allen, who rightly considered it essential to the success of the operation. Allen's method of attacking the spine was by an incision made through the gingivolabial border of the upper lip. I attack the spine through the floor of the nose by means of a saw, either sawing through it completely, or partially, and then fracturing it by the use of forceps. The continuous wearing of the retaining apparatus for a week or ten days was first suggested to me. After demonstrating to my satisfaction the advisability of this method over the old procedure of frequent removal and introduction, I presented it to the profession in a paper read before the meeting of the American Laryngological, Rhinological, and Otological Society, held in Pittsburgh on May 11 and 12, 1898.

Although my results had been unusually good through the former method of operation, there were yet a sufficient number of unfavorable results to wish for some operative procedure that would, with the execution of proper skill, give uniformly perfect results. As the literature seemed to bear testimony to uniform results following the submucous method, I determined to direct my attention to it.

I will briefly describe the submucous method for those not versed with its technique. The operation is most frequently done under cocaine anesthesia, either through the laying of pledgets of cotton saturated with a 10 per cent. solution or the rubbing in of the crystal of cocaine, or through the hypodermic injection of a solution of cocaine beneath the mucous membrane. The mucous membrane is also rendered ischemic through the use of suprarenal or adrenalin. After the anesthesia and ischemia are complete, a vertical incision is made through the mucous membrane and the perichondrium of the septum in that nasal cavity into which the bending of the septum presents itself. I find it preferable to incise into the cartilage in the primary incision, as well as to use the index finger in the other nasal cavity as a guide and safeguard against carrying the

incision too far. Some operators have a rule to make the primary incision in that nasal cavity in which the convexity of the deflection presents itself; other operators always from the left nasal cavity, whether it presents the concavity or convexity of the deflection. It is more convenient to operate in the left nasal cavity, as one must be expert with the use of the left hand to operate in the right nasal cavity. There is no doubt that it is preferable to operate in that side which presents the convexity.

Many, following the teaching of Killian, make a vertical incision from the dorsum, about 0.5 cm. posterior to the columna, extending to, if not including, the floor of the nose; others make the incision slightly curvilinear, but follow the same outline. Others, following the teaching of Freer, make the incision in the form of an inverted capital L over the point of greatest projection. In my early work, I followed the Killian incision, but latterly I have made the incision quite well forward, leaving only a narrow strip of cartilage between the line of incision and the columna. This has the especial advantage in that, in case a puncture is made through the perichondrium and mucous membrane when incising the cartilage, one may make another cartilaginous incision a millimeter or more farther back, and from that point raise the mucous membrane and perichondrium on the opposite side. Indeed, the deflection may be so placed as to render it necessary to make the incision directly posterior to the columna. I have never attempted the Freer flap. From the manner in which I have seen flaps retract when broken at their lower angle, and the absolute inability to draw them down so that they in any way come over the surface of the opposite flap, I should judge that Freer's flap must leave a large surface to cover by granulation.

The next step in the operation is the raising of the mucoperichondrium. The starting of the perichondrium is really the crucial point of the operation, for, as this is well done, so is the operation a success or a failure. A half sharp elevator is used for the beginning of the work. Care, patience, and the employment of plenty of time is requisite in this procedure. It is usually best to commence at the upper end of the incision, for here the soft structures are free from irritation, and will consequently separate with greater facility. One should gradually insinuate the half sharp separator between the soft tissues and the cartilage along the posterior border of the incision until he finds it raising the perichondrium slightly, then gradually work downward, producing the same degree of separation until the floor of the nose is reached. If the primary incision, at the lower point, or at any point, is not through the perichondrium, one is very apt to tear the flap at the point of non-separation. After separation is made throughout the whole length of the incision and backward for about 0.5 cm. with the half sharp separator, the final separation is rapidly finished with the employment of the full,

rounded separator, with the execution of proper care over sutural borders, over angles and points of adhesion. The mucoperichondrium should be separated thoroughly over the hard parts as far as the removal of cartilage and bone may be expected to extend.

The second important step is the incision through the cartilage made through the original wound and parallel to it without injury to the mucoperichondrium of the opposite side. This is one of the most important steps of the operation, and must be performed with exquisite sensitiveness of feeling and nicety of skill so as not to make a puncture through the perichondrium and mucosa. A puncture is almost certain to be attended with a subsequent perforation, however minute it may be. Very many methods have been suggested to obviate the use of the knife in this procedure, but in my experience, if extreme care is exercised, no other expedient is necessary. If such a misfortune is met with, it is wise to abandon the incision made through the cartilage and make another parallel incision through the cartilage a millimeter back of the original incision, and from this raise the perichondrium of the opposite side over the same area, and with the same care and delicacy with which it has been carried out on the other side. Always be careful to see that the mucoperichondrium on both sides has been well separated down to the floor of the nasal chambers. The third step is the removal of the deflected cartilage and bone between the two flaps which have been formed. Many remove the cartilage and bone between the flaps without any means of protection to the flaps. I consider this method unnecessary and unsafe. I always use the Killian long speculum to widen out the flaps and protect them from injury. The Killian, or some similar form of speculum, should always be used during this stage of the operation. The final procedure is the bringing of the flaps together and holding them in position by a packing of gauze. The gauze is usually removed in twenty-four hours, when union is found to be complete. The foregoing is practically the usual operative procedure. I have varied this slightly in my technique.

From observations which I have made in the clinics and private work of some of the most dexterous and rapid workers in this operative technique, and from my own experience, I early became convinced that cocaine anesthesia was not sufficient to relieve the patient of pain attendant upon its performance; also, that a suffering patient, with loss of fortitude, did not aid in the successful issue of such a delicate operation. In my early work I operated under cocaine anesthesia. In the early stage of the operation, under the use of cocaine, I found the anesthesia all that could be desired, but, as the operation was often prolonged, and the most trying part of the procedure came at the last, I found that most of my patients suffered quite a little pain and shock, and several of them became so demoralized as to render the completion of the operation extremely difficult. I therefore turned to general anesthesia, at first only operating upon

those under this method who I feared would not last out under local anesthesia. I found this method so satisfactory that, during the last two years, I have done all my septum operations under general anesthesia. By this method the patient is entirely free from the possibility of pain, and the operator is saved the disquietude resulting from the anxiety and suffering of his patient. The bleeding under general anesthesia is a little greater than under local anesthesia, but I have never found it sufficient to delay or annoy me during the progress of the operation. I have also found it wise to study carefully the relation between the convex surface of the deflection and the alæ of the nose, so that the incision will be made sufficiently well forward to avoid making a failure of the operation, on account of the alæ coming in contact with that portion of the cartilage that is left.

My results by this operation have been uniformly good for the relief of stenosis, contact with the turbinates, or the relief of reflex symptoms. In none of my cases has there been any sinking of the dorsum of the nose. Where there is sufficient bony structure left above and a fair bridge of cartilage anterior to the seat of operation, I doubt if this occurrence can take place. I doubt very much if there is ever a reproduction of cartilage or bone in the area from which it is taken. The flaccid septum becomes tense and later gives a certain firmness of sensation. In several of my cases in which a large portion of the hard septum was removed, my patients have been annoyed for a month or more by the flapping of the flaccid septum. The symptom of which they complained was the frequent alternate occlusion of the nasal cavities, due to the flaccid septum coming in contact with one, then the other, outer wall of the nose. I, unfortunately, have had perforations. Most of my perforations were made during my early operative days, and no doubt were largely the result of want of knowledge of the adequate skill to obviate and overcome the various pitfalls which in this operation present themselves from the very start to the finish of the operation. I know of no operation in which an operator has to be so "keyed" up and so carefully has to scrutinize every move in the technique as is required of a surgeon in this operation. Twice I have had two fairly large perforations to develop from pin-point incisions into the opposite mucoperichondrium at the point opposite the primary incision. In both of these cases I was conscious of the wound, and, before introducing the packing, I closely scrutinized the mucous membrane, hardly being able to note the point of injury; nevertheless, the perforation resulted. In all I have had 3 per cent. of perforations. In my last series of 80 cases I have had only one perforation, and this was one of the 2 described above. Twice when operating I have recognized the fact, from a misfortune, that a perforation would in all probability result if I continued the operation by the sub-mucous method; I therefore discontinued the procedure and resorted

to my former method. Perforations resulting after this procedure heal kindly and are not usually attended by crust formation, therefore give no annoyance to patients; in fact, patients are never conscious of their existence unless informed of it. If we could depend upon our confrères to be considerate in not notifying the patients of the existence of a perforation in their noses, they would be of no consequence, except the personal chagrin they cause the operator. During the last three years I have operated upon 190 cases of deflected septum by this method; 22 of the operations were done under local anesthesia, with 3 perforations; 168 were done under general anesthesia, with 5 perforations. During this same period I performed 20 operations by the method formerly employed by me, with only one perforation. The results gained through the two methods of operative procedure have been practically the same, except that, in the submucous operation, the septa presented cosmetically a more perfect appearance.

In sharp, angular deflections the introduction of the index finger into the cavity presenting the angle and gently but firmly forcing it over will cause it to assume a more rounded form so that the separation of the mucoperichondrium can be accomplished with more ease. Great care should also be exercised in seeing that ridges at the junction of the vomer and the maxillary crest have the mucoperichondrium raised so that they may be thoroughly removed. It is better to remove these ridges with the chisel, as through this instrument they can be expeditiously and more satisfactorily removed.

In considering the advantages which the various operations for the correction of the displaced septum offer over one another, we must not lose sight of the personal equation of the operator. Many operators can perform the older methods of straightening with a marked degree of success, and have not the patience or requisite skill to operate by the submucous method. Most operators find that experience is a great teacher in the submucous operation. Manœuvres that seemed almost impossible in the earlier operations become easy of manipulation after many have been done.

1. CONCLUSIONS. The old method gives a septum maintaining its anatomical integrity. The submucous operation gives a flaccid septum, minus certain elements formerly considered essential to its anatomical integrity. This removal of the cartilage and bone seems to have no influence upon the function of the parts, unless removed over too great area toward the dorsum of the nose.

2. The operation by the old method requires about ten minutes in its consummation; the submucous requires about one-half hour in actual operating time.

3. The old method requires the wearing of a splint for a week or ten days; the packing in the submucous operation is removed in twenty-four hours.

4. In the old method there is considerable pain and discomfort until the splint is removed; in the submucous there is no postoperative pain.

5. In the old method of operating the patient is confined to bed for several days, and is uncomfortable and feverish until the splint is removed. After the submucous operation the patient is out of bed at the end of twenty-four hours, and at the end of forty-eight hours is practically well.

6. The old method is rarely attended with perforation. I have had only two in my whole experience. Theoretically, the submucous method should be attended with like results; practically, perforations do occur. After performing one hundred and ninety operations by the submucous method and nearly twice as many by the older method, I have become firmly convinced that the submucous method offers the greatest advantages to the patient afflicted with a deflected septum, in the hands of an operator thoroughly skilled in its technique. I know of no operation wherein unskilled and inexperienced hands can do more harm than by this operation. I feel as though I am becoming a strong advocate of the submucous operation, because it gives less discomfort to the patient, it taxes the skill of the operator, and, when satisfactorily done, gives excellent results.

THE FURTHER REPORT OF A CASE OF TRACHEAL SCLEROMA.

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Two years ago I presented to the American Laryngological Association the history of a case of scleroma of the larynx.¹ Ten months later there was a recurrence of the growth and the patient presented herself hoarse and with dyspnoea very marked, and gradually becoming worse. Noting the remarkable results obtained in other cases of external rhinoscleroma by the use of the Röntgen-rays, I felt that their application direct to the part through an opening in the trachea might have a curative effect. In any event tracheotomy was becoming daily more necessary, and if benefit was not to be obtained the patient would be compelled to wear the tube, as had others before her, to prolong her life.

The patient readily consented to the operation and subsequent direct treatment by the Röntgen-rays, and on March 25, 1907, she

¹ AMER. JOUR. MED. SCI., 1907, cxxxiii, 751.

was admitted to the Mt. Sinai Hospital, in the service of Dr. A. G. Gerster.

The following are the notes of the examination by myself, on March 28: In the nose half way back on the left side is a grayish-white mass which bleeds very readily when touched and is covered with thick secretion. This mass does not occlude the nose on that side. On the right side is another similar mass partially occluding the nose. In the trachea, below the cords, on a level with the cricoid cartilage, is a mass attached to the wall of the trachea and extending downward. This is an extension and continuation of a condition existing for over a year under my observation, and is a scleroma of the larynx verified by the pathologist's report. The diagnosis is increasing tracheal stenosis due to scleroma, with secondary involvement of the intranasal mucous membrane.

Physical examination on March 30 showed: A fairly well-nourished young woman; facies somewhat dyspnoëic; hoarseness: respirations stridulous, difficult, gasping, and considerably prolonged in both phases; percussion signs somewhat diminished, especially posteriorly at the bases; apices free; vocal fremitus diminished; voice and whispering sounds diminished below in front and over the bases posteriorly; numerous sonorous and whistling rales over both lungs, anteriorly and posteriorly; in the axillary regions and over the bases posteriorly numerous moist rales, increased after coughing.

On March 30 Dr. A. G. Gerster did an extensive tracheotomy. The incision extended three and one-half inches from the lower edge of the thyroid cartilage to about three-quarters of an inch above the sternal notch. The isthmus of the thyroid was tied off in two places and divided between ligatures. The cricoid cartilage and tracheal rings were incised, bringing into view the tumefaction of the posterior and lateral aspects of the trachea. The newgrowth was grayish white in appearance, resembling soft mucous polyps readily breaking down, and extending one and one-half inches below the larynx. A large tube was introduced and packing about it to keep the wound open.

On April 1 the packing and tube removed. The edges of the wound were held apart by retractors, and under chloroform anesthesia there was a five-minute exposure to high-frequency current at a distance of eight inches.

April 3: has had frequent paroxysms of coughing. Whenever she sits up, is fed, dressed or in any way disturbed, these coughing spells occur, and frequently vomiting ensues. These phenomena were not present before x-ray treatment.

April 9, 12, 15, and 17: X-ray treatment by Dr. Stern, five- to six-minute exposures.

April 20: The growth has greatly decreased in size, and the trachea looks much wider. Has had no more vomiting and her

tracheal reflexes are less active. It is now possible to dress the wound and clean the tube without exciting coughing spells as formerly. X-rayed on the 22d and 24th.

May 10: Patient has had three or four x-ray exposures a week; an examination of her larynx by myself showed an absence of any tumefaction, and I recommended permanent withdrawal of the tracheotomy tube and further treatment externally. Voice now normal and no dyspnœa.

On May 11 the tube was removed; she remained until May 17 when she was discharged from the hospital cured. During her stay in the hospital her temperature never arose above 100.5°. After the first few times no chloroform was given prior to x-ray treatment. Urinalysis frequently made showed neither albumin nor sugar.

Examination April 12, 1908: Until the present time the patient has been in normal condition without dyspnœa, hoarseness, or cough. She has been attending to her work with regularity and only appears now at my request for examination. Her general condition is good, respiration normal, and she says that except for occasional nasal obstruction she is entirely well. On the right side of the nose about the centre of the inferior turbinate is a small pink mass which probably interferes slightly with her breathing. On the left side, on the septum at the floor, is a roundish mass about the thickness of a small hazel nut. This was removed with a cold wire snare and was about one inch in length. There was but a slight bleeding.

Examination of the larynx and trachea showed perfectly normal conditions.

More than a year has now elapsed since her operation and subsequent treatment, and no sign of recurrence is visible within the larynx or trachea, and we may justly consider her as cured of her most threatening condition.

The benefits of the x-ray application to external scleromas have been known, and now we can show its utility in local conditions that we are able to reach in a direct manner. Should a recurrence be present we might reasonably expect good results by external application of the x-rays over the cicatrix, this not presenting the same resistance as the normal tissues would; that failing it would be easy to reopen the old wound and make local application again.

I wish to express my thanks to Dr. A. G. Gerster and to Dr. Samuel Stern for their cordial coöperation and active interest in the surgical and x-ray treatment of the patient.

THE PRESENCE OF TUBERCLE BACILLI IN THE CIRCULATING BLOOD IN TUBERCULOSIS.¹

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THE principal reason for taking up a bacteriological study of the blood in tuberculosis was to determine whether a previous assertion, made in connection with my article on the presence of tubercle bacilli in the feces, was correct. This assertion was that, considering the entrance of the tubercle bacillus into the human economy, "the number of bacilli is not large, and they find their way to the blood and lymph stream; and during their transit some are discharged through the feces and others through the urine." Again, after examining the contents of 22 thoracic ducts from subjects dead of tuberculosis, tubercle bacilli were encountered in 72.7 per cent. This occurrence also led me to believe that all forms of tuberculosis are characterized by a bacteremia.

Some observers have been successful in obtaining cultures of the tubercle bacillus from the blood in cases of acute miliary tuberculosis, but the instances are not numerous. The studies undertaken by me were at first to prove that tubercle bacilli are present in the blood in all cases of tuberculosis, and to determine if possible the presence of organisms in the so-called mixed infections in the late stages of the disease.

Numerous clinicians have asserted that the termination of cases of pulmonary tuberculosis is accompanied by infections of the pneumococcus, *Streptococcus pyogenes*, staphylococci, and *Bacillus pneumoniae*. My own observations from examinations of the blood previous to the present study were usually negative as regards these mixed infections, as I never obtained any other organism besides the staphylococcus in quite a number of cases, even in those of tuberculous pneumonia. The occurrence of the staphylococcus was not considered as a possible infecting organism, but was usually looked upon as a contaminating organism from the skin.

In making up my list of cases for this research I first selected those who were bedfast and who presented advanced tuberculosis or cavity formation; then cases of acute miliary tuberculosis; and lastly, instances of incipient tuberculosis.

The technique for the demonstration of tubercle bacilli in the blood was as follows: About 5 c.c. of blood was withdrawn from a vein of the arm, and this was immediately placed in an equal quantity of a

¹ Read at a meeting of the Pathological Society of Philadelphia, December 10, 1908.

2 per cent. solution of sodium citrate in normal salt solution. The mixture was well shaken and placed in the refrigerator for twenty-four hours. At the end of this time there is an abundant sediment, with the citrate solution slightly turbid. Centrifugalization immediately after mixing did not give very good results, so I determined upon letting the mixture stand for twenty-four hours. After this time I pipetted off a quantity of the sediment, made a rather thick preparation upon a new, clean glass slide, dried it upon a copper plate with moderate heat, and then placed it in distilled water until complete laking of the blood resulted. At this time only a delicate film remained. This was dried and fixed through a Bunsen flame and then stained by the usual technique for tubercle bacilli. As a rule, bacilli possessing the morphological and tinctorial properties of the tubercle bacillus could be demonstrated in the first slide thus prepared, although in several cases three slides were thoroughly searched before any bacilli were found. A negative result should not be announced until at least thirty minutes careful searching has been given to a slide.

The pipettes before being used were thoroughly washed in water, then placed in pure nitric acid, and after being used were again washed, this time in a solution of caustic soda, rinsed, and again placed in pure nitric acid until ready for use. No one pipette was used on two different cases on the same day. Lately I have sterilized the pipettes at 160° C. for one hour and then placed them in nitric acid before using. The syringes used for withdrawing the blood, as well as the needles, were boiled for about twenty minutes before and after using in a solution of caustic soda. The needles were kept in a solution of equal parts of lysol and glycerin, and just before being used were washed in sterile water. The glass piston, as well as the nozzle of the syringe, was anointed with glycerin to prevent any undue adhesion of these parts. No special preparation of the patient's arm is necessary; lysol was simply applied upon the area as Wright practises in his opsonic work.

In the first few studies undertaken 10 c.c. of blood was withdrawn, then 5 c.c., and when for some unforeseen circumstance this amount could not be obtained from the patient 2 c.c. was taken. I would recommend 5 c.c. as the proper quantity to withdraw. Intimate mixing must be made lest the blood clot, in which case the greatest difficulty arises in demonstrating the organisms.

The cases studied up to the present time number 50. Of these, 5 were diagnosticated as acute miliary tuberculosis; 2 as fibroid tuberculosis; 1 as pneumothorax; 15 as incipient tuberculosis; 23 as moderately advanced tuberculosis; and 3 as laryngeal tuberculosis. I also had the opportunity of examining the blood from the umbilical cord of a placenta delivered from a tuberculous mother.

In every case examined tubercle bacilli were found. Sometimes only a few were seen, but they were mostly in large numbers, and

clumps of 30 to 40 bacilli were not unusual, especially in the cases of acute miliary tuberculosis. In morphology most of the organisms were of normal size, though some were short and even clubbed; a few very long forms were also encountered. In one of these cases the pneumococcus was seen. In several cases clumps of tubercle bacilli could be clearly observed in some of the leukocytes, indicating phagocytosis.

In a patient in whom tubercle bacilli were found in the feces on two different occasions, and who upon physical examination did not present any signs of the disease, the organisms were found in the blood, and about 2 c.c. of the citrated sediment was inoculated intraperitoneally into a guinea-pig. This pig died in about three weeks from an internal hemorrhage (peritoneal). The lungs were studded with tubercles, four tubercles were present in the liver, and enormous enlargement of the spleen as well as enlarged mesenteric glands were found at autopsy. Spreads from the liver, spleen, kidney, heart's blood, and mesenteric gland contained tubercle bacilli, but no other organism.

In a second case, diagnosticated as acute miliary tuberculosis, 2.5 c.c. of the citrated sediment was inoculated intraperitoneally into a guinea-pig. This animal was sacrificed at the end of five weeks, and presented the following lesions at autopsy: Four bronchial glands ranging in size from 0.5 to 1.5 cm. in diameter, several enlarged mesenteric glands, tuberculosis of the spleen, and only a few small tubercles in the lungs. Spreads from the spleen, mesenteric glands, and blood showed a few tubercle bacilli.

CONCLUSIONS. It appears that tuberculosis in all of its forms is a bacteremia. Even in healing cases, or in those in which the disease is being arrested, tubercle bacilli are demonstrable in the blood, although usually in small numbers. In subjects dead of the disease, if histological examination of the liver, spleen, and kidney are made, one would find scattered miliary microscopic tubercles, which strengthens the above assertion. Only a small number of cases are here reported,² but it seems that even in this small number the constant finding, especially in cases of incipient tuberculosis, before the detection of the bacillus in the sputum, is quite a valuable procedure. Again, it appears that the theory of mixed infection late in the disease does not always hold, for the reason that if tubercle bacilli are demonstrable by this method other organisms should be just as evident, and yet in only one of the cases studied was another organism—the pneumococcus—present. This patient had a pleural effusion, but was really in the incipient stage of pulmonary tuberculosis.

² Up to January 15, 1909, I have studied 125 cases, and have detected the tubercle bacillus in all.

REVIEWS.

APPLIED SURGICAL ANATOMY. By GEORGE WOOLSEY, A.B., M.D., Professor of Anatomy and Clinical Surgery in Cornell University Medical College. Second edition; pp. 601; 200 illustrations. New York and Philadelphia: Lea & Febiger, 1908.

THE author's revision of this work brings it well up to date and continues it in the position it has always occupied, as one of the most practically useful of the text-books of applied anatomy. Few of them contain so many separate items of information of importance to the practitioner, and in none of them is such material better arranged or presented in a more concise or more readable form. The book is so well known and so generally appreciated that in reviewing this edition the chief interest centres in the additions or changes which, since 1902, the progress of anatomy and surgery has necessitated, or which have been suggested by the widening experience of the author. A few examples taken at random may be given: In the section on the localization of cerebral functions, it is now said: Before the investigations of Sherrington and Grünbaum this area was thought to comprise the cortex of the anterior and posterior central convolutions, bordering the fissure of Rolando, and the cortex immediately adjacent to them, especially the paracentral lobule on the mesial surface. As the result of these observations on the higher apes, confirmed, in part at least, by histological studies and the faradization of the human cortex in the course of operations, the motor area is now thought to lie entirely in front of the central fissure and to extend to the bottom of it on its anterior surface only. In the same section the existence of the heat-regulating centre in the medulla is now noted; the teaching as to the visual speech centre has been modified, and it is correctly added that as the basis of language is a series of memory pictures (1) of the sound of words, (2) of their appearance, (3) of the effort necessary to enunciate them, and (4) to write their symbols, and as these memory pictures are connected with each other and with others that make up the concept by sub-cortical association fibers passing between them, a lesion in any of these association tracts also leads to a defect of speech.

In the section on the neck "enlargement" of the thyroid has properly become "hypertrophy;" the function of the gland is more fully dealt with; the parathyroids and their relations are well de-

scribed and figured, and attention is called to the fact that "removal of all the parathyroids or the destruction of their blood supply causes death from acute tetany. As the loss of their blood supply is the most frequent cause of tetany, great care should be observed in thyroidectomy only to tie the arteries that actually enter the thyroid."

In the section on the thorax a few lines on operations upon the heart have been added, but, in view of the results of operative interference in cardiac wounds, the description might have been amplified with advantage. In the section on the abdomen a number of advantageous changes have been made, a few cuts added, and some conspicuously useless ones (like Merkel's "Outlines of the Abdominal Viscera") omitted. The statistics as to gastric ulcer have been corrected and brought up to date. The former edition said, "Ulcer of the duodenum, as compared with gastric ulcer, is uncommon." In the present edition it is said that "ulcer of the duodenum was formerly thought to be uncommon, but among 200 cases operated upon, 98 were of the duodenum, 87 of the stomach, and 15 of both (Mayo). They occur mainly in the first 4 cm. (one and one-half inches) of the duodenum and altogether above the bile papilla, that is, in the area where the contents are acid." The article on the pancreas has been partly rewritten and enlarged. It would bear still further enlargement. A cut of the retropancreatic lymph nodes has been inserted, but there is no reference to it in the text except a rather misleading one relative to the position of the spleen (p. 375).

In the section on the lower extremity the description of the anatomy of dislocations of the semilunar cartilages has been made both fuller and clearer. In the section on the pelvic viscera, the "anorectal line" of Testut, and Hilton's "white line"—the "anorectal groove"—are for the first time described in relation to the anal portion of the rectum, and the freedom of that portion from involvement in prolapse (on account of its firm support by the levator ani muscle) is mentioned. Houston's folds as seen through a speculum are shown in a clumsy and space-consuming plate. Two smaller but much more useful cuts (from Spalteholz), showing the relation of the sphincters and the interior of the rectum, have also been added.

The section of the spinal cord has been well revised. The italicizing throughout seems a little overdone, the desired emphasis being sometimes lost by reason of the frequency with which the eye is called upon to recognize it. The space given to the time-honored, but largely useless, "cross-sections" of limbs might have been used to better advantage. A very few typographical errors were found, *e.g.*, "scapulabis" (Plate XIV, p. 184). But, on the whole, the book has been kept up to its previous high standard of accuracy and usefulness, and is among the most satisfactory of the treatises on this subject, whether for the student, the general practitioner, or the surgeon.

J. W. W.

OXFORD MEDICAL PUBLICATIONS:

HEART DISEASE AND THORACIC ANEURYSM. By F. J. POYNTON, M.D., F.R.C.P., Assistant Physician to the University College Hospital, London.

AUSCULTATION AND PERCUSSION. By SAMUEL GEE, M.D., F.R.C.P., Consulting Physician to St. Bartholomew's Hospital, London.

MEDICAL LECTURES AND APHORISMS. By SAMUEL GEE, M.D., F.R.C.P., Consulting Physician to St. Bartholomew's Hospital, London.

CLINICAL LECTURES AND ADDRESSES ON SURGERY. By C. B. LOCKWOOD, Surgeon to St. Bartholomew's Hospital, London.

SELECTIONS FROM THE WRITINGS OF SIR WILLIAM BROADBENT. Edited by WALTER BROADBENT, M.D., M.R.C.P.

GLANDULAR ENLARGEMENT AND OTHER DISEASES OF THE LYMPHATIC SYSTEM. By ARTHUR EDMUNDS, F.R.C.S., Surgeon to the Great Northern Central Hospital, London.

DIETS IN TUBERCULOSIS. By NOEL DEAN BARDSWELL, M.D., Medical Superintendent of the King Edward VII Sanatorium; and JOHN ELLIS CHAPMAN, M.R.C.S., Medical Superintendent of Coppin's Green Sanatorium.

THE TREATMENT OF DISEASE IN CHILDREN. By G. A. SUTHERLAND, M.D., F.R.C.P., Physician to the Paddington Green Children's Hospital, London.

THE SKIN AFFECTIONS OF CHILDHOOD. By H. G. ADAMSON, M.D., M.R.C.P., Physician for Diseases of the Skin to the Paddington Green Children's Hospital, London.

THE LAW IN GENERAL MEDICAL PRACTICE. By STANLEY B. ATKINSON, M.B., B.Sc., Justice of the Peace for the County of London.

LIFE INSURANCE AND GENERAL PRACTICE. By E. M. BROCKBANK, M.D., F.R.C.P., Honorary Assistant Physician to the Royal Infirmary, Manchester, England.

ROTUNDA MIDWIFERY FOR NURSES AND MIDWIVES. By G. T. WRENCH, M.D., Late Assistant Master of the Rotunda Hospital, Dublin, Ireland.

London: Henry Frowde, and Hodder & Stoughton, 1908.

THE foregoing comprise some of the excellent series of manuals recently issued from the Oxford University Press. Together they share the interest and importance that attach to monographs; they are small in compass and devoted to interesting topics, and they are written by authors well qualified by study and experience to discuss the respective subjects.

Dr. Poynton's volume consists of a clear and succinct statement of the clinical methods of investigating diseases of the heart, and of the pathology, symptoms, and treatment of the more important forms

of heart disease. Major significance and importance is attached to acute rheumatic heart disease, which is taken as a type, and from which other forms of heart disease are differentiated. This necessitates an unusual and a somewhat confusing discussion of the pathology, symptoms, and treatment; but it has the merit of emphasizing the widespread activity of the rheumatic poison—in implicating the pericardium, the myocardium, and the endocardium—and it is altogether pardonable in one whose painstaking studies of the bacterial cause of acute rheumatic fever and of rheumatic heart disease are well known and highly prized, and who has so much of value and so much that is original to relate. Especial interest centres in the chapters on myocardial and neuromuscular disorders of the heart, which are often more or less disregarded in the too common thought that heart disease and valvular disease are almost, if not quite, interchangeable terms. The discussions of treatment are rather full and very valuable: the local use of cold in acute cases is extolled; the salicyl compounds are believed to be of no value; the suggestions for the use of digitalis and strychnine are excellent. The chapters of congenital heart disease and on arterial disease and aneurysm are altogether too brief, even for a manual. The book as a whole can be warmly commended; perhaps some day the author may gratify many readers by expanding it to a more pretentious volume.

Dr. Gee's book on auscultation and percussion is now in its fifth edition—which of itself is sufficient evidence that it has for some time subserved a useful purpose. It has the special merit of being entirely personal; it relates in clear and terse language the important facts of physical diagnosis; and it avoids the distraction of extraneous discussions. It is unusually dogmatic, but its dogmatism may be excused, since the main object of stating facts is so well accomplished. Dr. Gee's *Medical Lectures and Aphorisms*, now in its third edition, comprises an unusual amount of medical wisdom and philosophy—graphically, succinctly, quaintly expressed. The general nature of the book may perhaps be best exemplified by several quotations: "Pneumonia is not a local, but a universal disease, and the brunt of it may fall upon any part—lungs, endocardium, membranes of the brain, intestines, kidneys." "Purgatives in dropsy are not of much use; the practice is a survival. If we cannot act upon the kidneys, we should do nothing to add to the patient's discomfort." "In women past middle age gallstones are so common that one is not wrong to be always suspecting them." "A letter containing four pages or more, closely written, and narrating the writer's own disorders, is a sure and certain sign of hypochondria." "When we have prescribed that continual temperance in all things which is necessary to the cure of most disorders, how often do we find that our patient reckons the loss of pain to be purchased too dear by the loss of pleasure." The quaintness and

what one may perhaps speak of as the elegance of diction lend an added charm to both books, of which certain chapters should be resorted to for pleasure in a leisure hour.

Mr. Lockwood's book consists of certain clinical lectures and addresses delivered from time to time and published elsewhere. Several of the more interesting are: Clinical reasoning; the recognition and management of intestinal obstruction; the essentials of a diagnosis; carcinoma of the breast and its spread into the lymphatics; exploratory laparotomy, especially in cases of malignant disease; clinical pathology in relation to diagnosis and treatment; and salivary calculi.

Mr. Edmunds' book comprises an interesting discussion of a much neglected subject, which is considered from a practical and a surgical standpoint; its limitations have been defined by considering only those pathological conditions in which affections of the lymphatic vessels or glands constitute the essential feature of the disease, such as cellulitis, acute infections, retropharyngeal abscess, glandular fever, chronic infections (especially tuberculosis) and their surgical treatment, diseases of the thymus gland, the surgery of the thoracic duct, lymphatic insufficiency, filariasis, dilatations of the lymphatic vessels, lymphadenoma or Hodgkin's disease, lymphangio-endothelioma, lymphosarcoma, the operative treatment of secondary malignant glands, and the treatment of inoperable malignant glands. The discussions are altogether commendable; the advice in regard to treatment is especially sound and practical. The book is a real addition to medical literature.

The volume of writings of Sir William Broadbent consists of a judicious selection from among the many papers of a distinguished author. Some of these have been selected because of their historic interest, such as that on the bilateral association of nerve nuclei (so-called Broadbent hypothesis), others to illustrate the variety of the author's work in his early days of professional life, and others because they are of present-day interest. Among the last named one may mention the examination of the heart (the author's last completed paper), adherent pericardium, pneumonia, interlobar empyema, acute dilatation of the stomach, some affections of speech, and syphilitic affections of the nervous system.

Bardswell and Chapman's *Diets in Tuberculosis* comprises the results of many years' study and investigation of diet and dietetics in general, but especially in regard to tuberculosis and the nourishing of the poor. They discuss the comparative economy of various foodstuffs, the economics of diets, and certain observations on the treatment of tuberculous patients with meat-free diet. They give the diet lists of several sanatoriums, certain practical directions for out-patients in regard to buying and cooking diets, and a dietary, costing sixteen cents a day in England, that has been found adequate for the treatment of pulmonary tuberculosis. The book is an

interesting and valuable addition to the already voluminous literature on tuberculosis.

The general scope of the other books, those by Drs. Sutherland, Adamson, Atkinson, Brockbank, and Wrench, is well exemplified in their respective titles. The discussions are in keeping with the excellence of the volumes of the series already issued. A. K.

HYDROTHERAPY. By SIMON BARUCH, M.D., Professor of Hydrotherapy in Columbia University (College of Physicians and Surgeons), New York; Medical Director of the Hydriatic Department of the Riverside Association. Third edition; pp. 544; 74 illustrations. New York: William Wood & Company, 1908.

In the third edition of his excellent text-book Dr. Baruch takes a very broad view of his subject, including even the antiseptic effects of hot water in surgery.

The first section is devoted to the physiological action of water. The various experiments cited are more interesting than decisive, as may be learned from Dr. Baruch's conclusion, "that, despite some differences of opinion and deductions, the changes produced by the thermic and mechanical stimulation arising from hydriatic procedures are very intense and far-reaching. The inference is as clear as day that an enormous influence must be exercised by procedures which impress such changes upon the caliber of the vessels, the action of the heart, and the composition of the blood in health; and that its effect in disease must be equally pronounced." The "musts" in this sentence are sufficient proof that the exact nature and influence of the changes are not yet sufficiently understood. Dr. Baruch has, we believe, at last impressed upon the profession, by his untiring persistence, the doctrine "that the antithermic uses of water are of far less value than its other qualities in febrile conditions," and that its real service is the stimulating influence upon the central nervous system, which is brought about by the reaction and manifested by the clearing up of those symptoms which we usually ascribe to febrile intoxication, but he also illustrates how firmly the antipyretic idea is impressed upon the medical mind by referring to "the good results in reduction of temperature" produced by ablution, the very first method described, and referring again to it in almost every other method.

In proof of his contention of the slowness of the antithermic result, he brings in evidence the slight reduction of the rectal temperature, which he regards as incomparably more accurate than the mouth or axillary temperature. This is a point upon which con-

siderably more investigation is required. His advocacy of the Brand method is undiminished in fervor, and the evidence he brings forward in favor of the reduction of mortality that follows its routine use is very convincing. As he justly remarks, the small experience of the average practitioner is practically worthless in comparison with the magnificent statistics obtained in various hospitals throughout the world. Even, perhaps, the inexact use of cold bathing in typhoid fever has produced a considerable decrease in the hospital mortality in this country, and for this also Baruch more than any other man is responsible, for he has taught the practitioners that cold bathing is good in typhoid fever, and they practise it without any very definite idea of the method. Dr. Baruch inveighs against the prejudice of the medical profession. We think it fairer to say the ignorance of the medical profession. By his own showing, there is only one medical college in the United States in which hydrotherapy is given adequate recognition. It cannot be supposed that the practising physician will look with favor upon a method of which he understands little or nothing; that is abused by quacks and charlatans, largely because of ignorance; and that requires either considerable personal effort on the part of the physician in educating members of the family, or the services of a trained nurse, who, perhaps, may need as much instruction. Much stress is laid upon the importance of accurate technique. In this we agree very heartily with Dr. Baruch. The indefinite directions given by the average practitioner are more calculated to do harm than good. The chapter on the hydriatic prescription deserves very careful and repeated reading.

In the special part the enthusiast is revealed. We are all, nowadays, ready to admit the paramount value of hydrotherapy in typhoid fever, but either the medical profession is difficult to convince or there is some error in the results obtained in cerebrospinal meningitis, pneumonia, Asiatic cholera, and in a variety of other diseases, even including chronic malaria. A reduction of 66 per cent. in the mortality of pneumonia, brought about almost exclusively by bathing, if correct, would make it imperative upon every practitioner to use this method. In functional nervous diseases and malnutrition its virtues are lauded.

The book concludes with a rather brief historical chapter. It can be commended as admirable in itself and almost the only adequate text-book on the subject in the English language.

J. S.

OPERATIVE MIDWIFERY. By J. M. MUNRO KERR, M.B., C.M. (Glasgow), Obstetric Physician to the Glasgow Maternity Hospital. Pp. 691; 294 illustrations. New York: William Wood & Co., 1908.

As stated by the author in his preface, it is many years since a book has been published in the English language dealing with operative obstetrics alone. In the period between the publication of Barnes' last edition in 1886 and the present, the whole obstetric viewpoint has been changed and the horizon enlarged, so that this department of medicine is now justly regarded as a surgical specialty. This may be looked upon as the author's apology for the publication of the volume, but after a most careful reading of the book we feel that none is needed.

The first twenty chapters, comprising 300 pages, are concerned with a consideration of dystocia, the remainder of the volume being given to a consideration of the operative technique. The first chapter of this latter portion gives a detailed account of the preparation of the patient, operating room, instruments, etc., while the next eight chapters treat of the various obstetric operations, such as the use of forceps, version, Cesarean section, and craniotomy. Then follow chapters on the manual removal of the placenta, abortion, placenta prævia, ectopic pregnancy, postpartum hemorrhage, and premature separation of the placenta. The last three chapters of the book are taken up with a study of the accidents to the mother and child. In an appendix of three pages an account is given of the method of determining the pelvic measurements by the Röntgen rays, which has been contributed by J. R. Riddell.

There are singularly few matters, either conclusions of the author or his method of presentation, with which the profession of America will not be in hearty accord. However, we cannot follow him in his suggestion as to the use of cocaine in certain types of cervical rigidity, nor in his advocacy of surgical anesthesia in primiparæ at the time of delivery of the head; in the former instance, because of the danger of infection and because there are better modern methods of meeting the indication; and in the latter, because of the danger of relaxation of the uterus, with resulting hemorrhage (the author calls attention in another portion of the work to the dangers resulting from a prolonged use of small amounts of anesthetic agents during the second stage). We also question whether American ophthalmologists will agree with his favorable prognosis in albuminuric retinitis, and we consider his method of closing the uterine wound after Cesarean section to be distinctly inferior. One of the most striking variations from the generally accepted teaching in this country is his statement that he does not consider the induction of labor of decided value in cases in which the true conjugate measures 8.7 cm. and above; he would limit its

employment to diameters between 8.1 and 8.7 cm. While we agree with him in the restriction applied to those below 8.1 cm., we feel that one of the most valuable indications for the operation is offered by diameters between 8.7 and 9.5 cm.

In considering the question of dilatation by the use of bags, we are glad to find that the use of the Pomeroy model is advocated, but we are sorry that the simpler model of Voorhees has not been at least mentioned as a substitute for the Champetier-de-Ribes. We must confess to an inability to understand the position assumed by the author when he advocates the vaginal Cesarean operation up to the twenty-fifth week, when rapid emptying of the uterus is demanded, but the abdominal method after this period. This is even more remarkable since the author believes in the operation in certain rare cases of eclampsia. We feel rather doubtful as to the correctness of the opinion that in face presentations it will be found that the posterior is the more usual position of the chin.

One of the most satisfactory chapters in the book is that upon the indications for, and the use of, the obstetric forceps. We are particularly pleased to note his universal use of the axis-traction principle, and his emphatic warning against the unjustifiable employment of forceps. He emphasizes the fact that brute force has no place in any obstetric operation, and strongly advises against the use of forceps in any case in which the conjugate measures less than 8.7 cm. He also demands that the head be well fixed at the brim, without overlapping, and that considerable time be given to allow of moulding. He is strongly of the opinion, which is fortunately becoming more general, at least among specialists, that cases with a more severe grade of deformity had best be delivered by some other method. His attitude here is the one consistently held throughout the book, as is shown repeatedly by his method of dealing with the various subjects considered, namely, that the midwifery of the future is to be a surgical specialty to be practised by men especially trained to deal with complicated cases. His chapter upon the metallic dilatation of the pregnant cervix is eminently satisfactory; indeed, we consider it as fair a presentation of the subject as could be written. He does not wildly enthuse over one special method, but, as the result of his own experience, he concludes that obstetrics has been advanced very decidedly both by the invention of Bossi and by the introduction of vaginal Cesarean section.

The presentation of the general subject of pelvic deformity is particularly to be praised, and his statement, when considering the indications for the special operations, that "if an operator says to me, before or early in labor, 'this is a case for symphyseotomy,' I invariably think he does not quite appreciate the refinements in the choice of operations for pelvic deformity," clearly reveals the attitude of judicial conservatism everywhere to be noted throughout the volume. As may be inferred from the above quotation, he is not

an advocate of symphyseotomy as a substitute for Cesarean section, forceps, or craniotomy, but believes that it still has a limited sphere, and also most emphatically believes that there are definite indications for the various methods of delivery, and demands, at least of the specialist, that these indications be respected. He is not impressed with the advantages claimed for pubiotomy, as contrasted with symphyseotomy, but does not consider that experience as yet justifies positive statements. His views as to the inadvisability of performing Cesarean section upon patients who have been subjected to unskilful attempts at delivery, or unclean examination before coming into his hands, are, as we understand them, those of the more rigid of the Continental and American schools, and seem to us possibly a little extreme, necessitating, as he admits, the not infrequent perforation of the living child.

In general, it may be stated that the work is a clearly expressed and scholarly production, well illustrated; that it comprises a most thorough and comprehensive consideration of all the matters germane to the work; and that a most delightful spirit of judicial fairness is in evidence throughout, without in the least leaving the reader in doubt as to the particular individual preferences and opinions of the author. The profuse references to the literature given in foot-notes throughout the book, together with the historical matter introduced, form a valuable and attractive feature of the work.

W. R. N.

A TEXT-BOOK OF MINOR SURGERY. By EDWARD MILTON FOOTE, M.D., Instructor in Surgery, College of Physicians and Surgeons, Columbia University, New York. Pp. 752; 407 illustrations. New York and London: D. Appleton & Co., 1908.

THIS volume upon minor surgery seems to fulfil, so far as the reviewer is aware, more nearly than does any other book of similar title the purpose for which it is intended. As a rule, authors have heretofore been satisfied to consider bandaging, ligations, amputations, excisions, and the like to be ample to write a book upon, even though the manuals and text-books include the same topics in their contents. Foote, however, has produced a book which discusses in detail the why and the wherefore of morbid conditions seen in the receiving ward and the surgical dispensaries, with their appropriate treatment. There are eight sections, comprising affections of the head, neck, trunk, genito-urinary organs, anus and rectum, arm and hand, leg and foot, and minor surgical technique. The injuries, inflammations, tumors, and deformities are separately considered in each section, and in the last section operative technique, bandaging, and the various surgical dressings are discussed. The principal

fault, it seems to the reviewer, is the failure of the author to appreciate the dividing line between the so-called minor and major parts of surgery. Perhaps this was inevitable if the book were to be of value, but it has led, through brevity, to many inaccuracies in the description of the pathology of some diseases. It hardly seems creditable that in modern times a surgeon should advocate non-interference with the lymph nodes in very early cases of carcinoma of the lip. No mention whatever is made of the value of the so-called Bier treatment for many of the conditions with which the author should be most familiar, nor is there any mention of the use of bacterins in the treatment of acne or persistent suppuration in certain localities. As an example of the sacrifice of exactness in order to conserve space, it may be mentioned that in discussing torticollis no mention is made of the spasmodic form which often requires nerve resections and is not amenable to tenotomy or manipulation, the only treatment referred to. Too much space is given, as is usual, to bandaging.

Notwithstanding these few criticisms, and perhaps many other imperfections which could be picked out here and there, the volume remains the best one upon its subject that has yet been written; and includes in its pages so many conditions which entirely escape mention in text-books upon surgery as to make it invaluable to the practising physician, the hospital interne, and the dispensary surgeon. Especial praise can be given the illustrations, which are not only new and clear, but are also accurately described by the legends. Attention should be drawn to the error on page 298, where a solution of nitrate of silver is recommended of the strength of 900 grains to the ounce.

G. P. M.

KIRKES' HANDBOOK OF PHYSIOLOGY. Revised and Rewritten by CHARLES WILSON GREENE, A.M., PH.D., Professor of Physiology and Pharmacology in the University of Missouri. Sixth American edition; pp. 723; 507 illustrations. New York: William Wood & Co., 1907.

A TEXT-BOOK OF PHYSIOLOGY. By ISAAC OTT, M.D., Professor of Physiology in the Medico-Chirurgical College, Philadelphia. Second edition; pp. 815; 393 illustrations. Philadelphia: F. A. Davis Co., 1907.

A TEXT-BOOK OF PHYSIOLOGY. By WILLIAM H. HOWELL, M.D., LL.D., Professor of Physiology in the Johns Hopkins University, Baltimore. Second edition; pp. 939; 281 illustrations. Philadelphia and London: W. B. Saunders Co., 1907.

THE aforementioned are new editions of well-known books on physiology. Each possesses features that have attracted to it a wide circle of readers. Kirkes' book furnished the pap that years ago

brought many mewling students of medicine on both sides of the Atlantic Ocean to professional maturity. Under the fostering hand of Dr. Greene, although the general arrangement of past editions has been adhered to, the quality of the present edition has been improved. The text has been largely rewritten, many new illustrations of physiological experiments and directions for laboratory work have been introduced, while the anatomical discussions have been curtailed. On the whole, the book may be cordially recommended—reflecting the best of the past, rejuvenated with new data of more recent times.

Dr. Ott's book has been much enlarged—by the addition of 240 pages and 250 illustrations. It has been much revised and considerably rewritten; the section on electrotherapy has been expanded, that on the sympathetic system entirely rewritten, and that on vision recast; less extensive alterations have been made elsewhere throughout. The book as a whole seems peculiarly adapted to the uses of Dr. Ott's own students.

Dr. Howell's book has undergone no fundamental change in arrangement or scope. Additions and changes have been made freely throughout the work, with the object of keeping the presentation of the subject abreast of the times, but as far as possible the additions have been counterbalanced by the elimination of such material as could be spared. If the book possesses features that distinguish it from others of its kind, these comprise evidences of breadth of view on the part of the author and his constant insistence upon the fundamental importance of basing the practice of medicine upon the teachings of physiology. The practical aspects of the subject are in evidence throughout the book—which can be cordially recommended as an interesting and philosophical treatise of value alike to the student and the practitioner.

A. K.

PROGRESSIVE MEDICINE. A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES, AND IMPROVEMENTS IN THE MEDICAL AND SURGICAL SCIENCES. Edited by HOBART AMORY HARE, M.D., Professor of Therapeutics in the Jefferson Medical College. Assisted by H. R. M. LANDIS, M.D., Demonstrator of Clinical Medicine in the Jefferson Medical College, Philadelphia. Vol. IV, 1908; pp. 333. Philadelphia and New York: Lea and Febiger, 1908.

THE concluding volume for 1908 of *Progressive Medicine* opens with a statement of recent advances in diseases of the digestive tract by David L. Edsall. Among the important subjects discussed are a new swallowing sign of value in the diagnosis of stricture of the

oesophagus, the physiology of the digestive processes, methods of gastric analysis, the size and position of the stomach, acute dilatation of the stomach, gastric ulcer, gastric carcinoma, tests for occult blood, appendicitis, carcinoma of the appendix, intestinal tuberculosis, intestinal obstruction, pancreatitis, jaundice, cirrhosis of the liver, etc. J. Rose Bradford discusses diseases of the kidney, devoting special attention to tuberculosis, syphilis, chronic nephritis, bacilluria, pyelonephritis in pregnancy and the puerperium, etc. Joseph C. Bloodgood discusses shock, hemorrhage, anesthesia, wounds and their treatment, the surgery of the bloodvessels, of the muscles, and of the joints, and tumors. William T. Belfield treats of genito-urinary disorders—gonorrhœa, tuberculosis, tumors of the kidneys, renal calculi, diseases of the bladder and the prostate, etc. The volume closes with a practical therapeutic referendium by H. R. M. Landis, who clearly and succinctly sets forth the important advances in therapeutics during the preceding twelve months. One cannot say more of the volume as a whole than that it continues to justify its existence and to merit the confidence of the profession; it is a worthy successor of those that have gone before. A. K.

THERAPEUTICS: ITS PRINCIPLES AND PRACTICE. By HORATIO C. WOOD, M.D., LL.D., Emeritus Professor of Materia Medica and Therapeutics in the University of Pennsylvania. Thoroughly Revised and Rewritten by HORATIO C. WOOD, JR., M.D., Associate Professor of Pharmacology in the University of Pennsylvania, Philadelphia. Fourteenth edition; pp. 778. Philadelphia and London: J. B. Lippincott Co., 1908.

SINCE Wood's *Therapeutics* was a pioneer of its kind, and has been, for more than a generation, the standard by which similar books have been measured, criticism is disarmed by the passage of time and a splendid record. At present, therefore, it suffices to chronicle the publication of a new, the fourteenth, edition. Many minor and a considerable number of noteworthy changes have been made throughout the volume in an effort to make it fully representative of the present state of pharmacology and therapeutics; the chapter on cathartics has been completely rewritten, that on diuretics has been remodelled to make it correspond with present views on the physiology and pharmacology of the subject, and new chapters have been added on opsonic therapy and the ion theory. As an exposition of the objects and aims, the science and art of drug therapy, the book is unsurpassed and doubtless will long continue to enjoy, as it merits, the unbounded confidence of the profession.

A. K.

PROGRESS OF MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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A Simple Method for the Serum Diagnosis of Syphilis.—TSCHERNOGUBOW (*Berl. klin. Woch.*, 1908, xlv, 2107) publishes a preliminary note on a simplified technique for the serum diagnosis of syphilis. The procedure is based on the following considerations: Fresh blood of a syphilitic patient contains the complement and the so-called syphilitic antibody in the serum. If extract of a syphilitic liver (syphilitic antigen) is added *in vitro* to such a blood diluted with a definite quantity of physiological salt solution, the mixture placed in a thermostat at 38° C. for one hour, and then inactivated serum, which is hemolytic for human red blood cells, is added, and the whole again placed in an incubator for two hours, there is formed a closed chain between the syphilitic antibody, the syphilitic antigen, and the complement, in which the complement is bound. Thus, the further addition of inactivated hemolytic serum is without effect upon the red blood corpuscles, since there is no available complement. If no syphilitic antibody is present in the blood, the complement remains free and hemolysis occurs after adding inactivated serum. The technique of the reaction is simple. One pricks the finger or ear of the patient, draws 0.1 c.c. of blood into a pipette, and dilutes it with about 1 c.c. of 0.9 per cent. sodium chloride solution. The Zeiss blood mixing pipette for white cells (1 to 10) is convenient for this purpose. The contents of the pipette are well mixed and emptied into a narrow test-tube (No. 1). Similarly, a second tube is filled (No. 2). Tube No. 3 contains blood diluted to the same degree with extract of a syphilitic liver in 0.9 per cent. sodium chloride solution. Tube No. 4 is prepared in the same way as No. 3. All four tubes are now placed in an incubator at 38° C. for one hour. At the end of this time 0.25 c.c. of inactivated serum hemolytic to human red blood cells is placed in Tubes 1 and 3. To

Tubes 2 and 4 a like quantity of 0.9 per cent. sodium chloride solution is added. All the tubes are again placed in an incubator for two hours and then in the ice chest over night. The result is noted the following morning. In Tube No. 1 hemolysis should always be found (if the serum contains complement). In the second tube there should be no hemolysis, as the red blood cells are in an isotonic salt solution. The result in the third tube will depend on the presence or absence of syphilitic antibody in the blood. If it is present the complement has been bound before the inactivated hemolytic serum was added, and no hemolysis occurs. If absent, the opposite result is obtained. The fourth tube simply serves as a control against any hemolytic action by the liver extract. Subsequently, Tschernogubow will describe the method in greater detail. It has proved trustworthy in his hands in a large number of cases. Its advantages are simplicity, the small amount of blood required, and the rapidity with which it can be carried out.

Precipitate Reaction with Lecithin, Sodium Glycocholate, and Sodium Taurocholate for the Diagnosis of Syphilis.—WM. J. BUTLER and W. T. MEFFORD (*New York Medical Journal*, 1908, lxxxviii, 822). Since the discovery of the serum reaction for syphilis many researches have been carried on to determine the identity of the substances contained in the extract used in the reaction, as well as to simplify the test. These researches have led to the use of other reactions in which, although the principle may vary, yet the result in each instance consists in a precipitate. Butler and Mefford have worked with the serum reaction and have compared the results obtained with it in the same cases, by the precipitate test. The performance of the latter test is comparatively easy and unattended with the many difficulties confronting one in making the complement-deviation test; it is made by mixing equal quantities of the serum to be examined and the precipitate reagent in a test tube and allowing it to stand at room temperature from fifteen to twenty hours. If the reaction is positive a precipitate will have formed and floats at the top of the fluid; on slightly tapping the tube it will descend in flocculi or whitish clouds. A turbidity of the fluid is not diagnostic. The results of these various tests in 74 cases examined may, according to these observations, be summed up as follows: The serum reaction surpasses in the percentage of positive results and in reliability the precipitate reactions for syphilis and parasyphilis. The glycocholate and taurocholate of sodium, especially the former, shows a large percentage of positive results in manifest syphilis, and a remarkably small percentage of positive reactions in control sera. The taurocholate gives the best results in positive reactions with parasyphilitic sera. The lecithin test is very unreliable and is definitely non-specific for syphilis. The results with active and inactivated sera in the control cases were practically alike with the glycocholate and taurocholate, but in the syphilitic and parasyphilitic cases an inactivated serum gave the greatest number of positive results, especially when the glycocholate was used. Butler and Mefford believe that more work will have to be done with these reactions before their real value can be determined, but in their examinations they found the test satisfactory; few positive reactions were obtained with these salts in the controls examined.

Hemophilia.—MOROWITZ and LOSSEN (*Deut. Arch. f. klin. Med.*, 1908, lxxxiv, 110) found in a case of hereditary hemophilia the usual prolongation of the coagulation time. From their studies upon a patient's blood they have shown that the delay in the coagulation time is to be attributed to insufficient formation of the fibrin ferment factors, especially the thrombokinase which is derived from blood platelets and leukocytes. That this is the only etiological feature of importance they do not assume. By means of suction applied to the skin of the back they were unable to demonstrate any greater liability to hemorrhage in their patient than in three normal adults examined.

Diphtheria Bacillus Septicemia.—UCKE (*Fortschr. der Med.*, 1908, xxvi, 1005; *Zentralbl. f. Bakt.*, Band lvi) describes a patient with impure heart sounds, frequent pulse, trace of albumin in urine, an area of inflammation without fluctuation in the right gluteal region. The patient had had high fever for two weeks preceding admission to the hospital. An angina with membrane had preceded the inflammation of the gluteal region, and Loeffler's bacillus was found in the throat. Operation on the right gluteal region was without result at first and blood culture was negative. No result followed the injection of 300 units of anti-diphtheritic serum. At a subsequent dressing of the wound, however, large quantities of pus discharged through a fistulous opening. In the pus, diphtheria bacilli were found; their virulence was greatly diminished, as animal experiments showed. A second blood culture gave a pure growth of diphtheria bacilli. Only three similar cases are recorded in the literature.

Chyluria.—MAGNUS-LEVY (*Ztschr. f. klin. Med.*, 1908, lxvi, 482) reports his study of a case of chyluria. The patient was a man aged fifty-one years, from Western Prussia. Six years previously he had noted that his urine was white and turbid during the winter, but in the spring and summer, became clear. The condition had recurred regularly each winter since then. The only complaints were pain in the back, especially on the right side, and pain on micturition. At times clots were voided. In January, 1908, the patient complained of thirst, loss of weight, and polyuria. Urinary examination revealed chyluria and diabetes mellitus. The night urine was chylous; the day urine clear. On reclining during the day and sleeping upright in a chair, the urinary finding was reversed. The withdrawal of fat from the diet led to clear urine at night, but the other constituents of chyle, such as albumin and lymphocytes, were still present in the night urine. With increasing quantities of fat in the food, a corresponding increase in milkiness of the urine occurred. Fibrinogen, albumin, and globulin were determined by fractional precipitation with ammonium sulphate. Cystoscopy revealed the fact that the chylous urine came entirely from the right ureter. The urine was collected from the two kidneys by catheterization of the ureters and analyzed separately. By computation Magnus-Levy shows that the proportion of fat, albumin, and sodium chloride in the chylous urine corresponded exactly with the composition of chyle as given by Munk and Rosenstein. No ova or embryos were found in the urine, nor was the blood serum fatty. There are two theories as to the origin of chyluria: (1) That the condition

results from direct addition of chyle to the urine, and (2) that the abnormal constituents are derived from the blood, no communication existing between the urinary and lymph passages. A defective catabolism of the chylous material is assumed. If the latter theory were correct, all cases of chyluria should be bilateral. Furthermore, direct communication has been found in a certain number of cases. In two-thirds of all the cases chyluria disappears either in the reclining or upright posture, and that would be impossible if the blood condition were the cause of the chyluria. The constant finding of lymphocytes in cases in which centrifugalized urine is examined also points to direct admixture of chyle. If one extracts sufficient urine with ether, cholesterol and lecithin are found. Their quantity in the chyle depends largely upon the diet. Again, the absence of glycosuria in chyluria has been urged as an argument against direct admixture of chyle to urine. But, as the author points out, Munk and Rosenstein have shown that chyle contains about 0.1 per cent. sugar on a fat and proteid diet; 0.3 to 0.4 per cent. after a carbohydrate meal. Only in the latter condition would one expect to find a glycosuria. The absence of clotting in some cases is also without significance, for in certain instances lymph and chyle fail to clot. Magnus-Levy assumes that in all cases a direct communication must exist between the lymph vessels and some part of the genito-urinary tract. The absence of chyluria for months and years at a time might be explained by the closure of the opening, the widening of the lymph vessels, or the establishment of collateral channels. The daily intermissions must be explained on purely mechanical grounds. This explanation of chyluria holds good both for parasitic and non-parasitic cases.

A New Test for Bile Acids and the Detection of Bile Acids in the Urine.—

Since Pettenkofer's test is not specific for bile acids, giving a red color with albumin, urea, carbohydrates, fatty acids, etc., it is necessary in applying it first to separate the bile acids in the urine. Confusion may also arise in the spectroscopic examination. Therefore, a new test for the detection of these acids is desirable. JOLLES (*Hoppe-Seyler's Zeit. f. physiol. Chemie*, 1908, lvii, 30) has devised a test for bile acids in which the reagents used are 5 per cent. rhamnose solution and concentrated hydrochloric acid. If one adds one to two drops of rhamnose solution to 2 to 3 c.c. of dilute (0.1 per cent.) solution of taurocholate or glycocholate of sodium and then an equal amount of concentrated hydrochloric acid to the mixture a rose color appears on gently boiling. This color soon disappears, and after standing a short time a beautiful green fluorescence supervenes. If the same experiment be repeated with 1 per cent. solutions of taurocholate and glycocholate, boiling produces a deep red color. On continued boiling the fluid appears reddish brown with transmitted light, malachite green with direct light. Neither glycocholate nor taurin gives this reaction. It is, however, given by cholalic acid as shown by the following experiments: When two drops of 5 per cent. rhamnose solution and 2 c.c. of concentrated hydrochloric acid are added to 2 c.c. of 0.1 per cent. alcoholic solution of cholalic acid (Merck), a white cloud appears from precipitation of the acid. On warming the mixture a red color develops, changing into a beautiful green fluorescence on boiling. A substitution of sulphuric acid for

hydrochloric gives less satisfactory results. From the rhamnose solution Jolles has found that methyl furfural is formed by the action of the hydrochloric acid. A solution of methyl furfural may be substituted for the rhamnose solution without altering the results of the test. But there is no advantage in doing this. In solutions the brilliancy of the fluorescence is dependent upon the concentration of the bile acids and, therefore, with very small quantities of cholalic acid the fluorescence is diminished. The minimum amount of cholalic acid in 1 c.c. of alcohol which can be detected by adding 1 drop of 0.1 per cent. rhamnose solution and 0.5 c.c. of concentrated hydrochloric acid varies between 0.005 and 0.001 gram. To render the green fluorescence more marked 1 to 2 c.c. of ether may be added after cooling and the contents of the test tube shaken. The fluorescence is then seen in a watery solution. None of the confusing substances with Pettenkofer's test will give a positive reaction with Jolles' test. For the recognition of bile acids in the urine one adds 15 c.c. of 3 per cent. casein solution (3 grams casein in 100 c.c. of water) to 50 c.c. of urine. This is well mixed and 10 per cent. sulphuric acid is added drop by drop (usually 0.6 to 0.8 c.c. is sufficient) until all the casein is precipitated. An excess of sulphuric acid is to be avoided. The contents of the test tube are now filtered and the precipitate is washed into a beaker with 100 c.c. of absolute alcohol and allowed to digest at ordinary temperature for about one hour. This is then filtered and 4 to 5 c.c. of the filtrate are placed in a test tube with one drop of 5 per cent. rhamnose solution and 4 to 5 c.c. of a concentrated hydrochloric acid. The mixture is heated to boiling and the boiling continued for one to two minutes. After cooling the contents of the test tube about 2 c.c. of ether are added and the contents shaken. In the presence of bile acids the characteristic green fluorescence is seen. The test will detect as little as 0.5 per cent. of sodium taurocholate; in concentrated urines and those rich in indican and aromatic oxy acids the test is less delicate.

The Presence of Mydriatics in the Urine.—DIEM (*Deut. Arch. f. klin. Med.*, 1908, lxxxiv, 174) has repeated the work of Pal, testing the urine of nephritics and others for mydriatics on the enucleated eye of a frog. The work of Schur and Weisel seems to point to an increased quantity of adrenalin in the blood of nephritics. Diem has tested the urine in a great many patients and finds that of a little over one-half the nephritics examined produced a marked widening of the pupil in the frog's eye. This phenomenon is not, however, characteristic of nephritis, being observed with almost equal frequency in other diseases. The substance which caused the mydriasis could not be determined, but Diem thinks various factors are concerned; that it is possible that substances are present in many urines which inhibit mydriasis; and that it is highly improbable that the test is specific for adrenalin in the urine.

Specific Stimulation of the Intestinal Peristalsis by Intravenous Injection of "Peristaltic Hormone."—ZUELZER, DOHRN, and MARXER (*Berl. klin. Woch.*, 1908, xlv, 2065) were led to the study of intestinal peristalsis by the work of Starling on the mammary gland and that of Bayliss and Starling on secretion. They suspected that a hormone existed in the

stomach which acted as a specific stimulus to intestinal peristalsis, and they succeeded in demonstrating such a body in the gastric mucosa, to which they gave the name "peristaltic hormone." To obtain it the animal must be taken at the height of digestion. It is not obtained from the fasting stomach. This hormone, like others, acts through the blood. If one injects it intravenously in the rabbit, an energetic contraction extending from the duodenum to the rectum begins in a few seconds. To prepare the hormone, they extracted the gastric mucosa with salt solution or dilute hydrochloric acid and precipitated the albumin with alcohol. The stomachs of various animals, the rabbit, pig, horse, and cattle, contained the hormone. In cattle it is only found in the glandular part of the stomach. A similar hormone, weaker and not constantly present, may be obtained from the duodenal mucosa. In a subsequent communication the authors will consider the therapeutic uses of this body. [The possible importance of this discovery from a therapeutic standpoint is easily appreciable.—W. S. T.]

The Ethereal Sulphates in the Urine in Auto-intoxications.—R. BRUNON and M. GUERBET (*Presse médicale*, 1908, lxxxv, 673) have noted previously that the proportion between the ethereal sulphates and the total nitrogen may be of great service in the diagnosis, treatment, and prognosis in cases of auto-intoxication. In the normal individual the quotient obtained by dividing the amount of ethereal sulphates by the total nitrogen gives figures usually varying between 1 and 1.4; whereas, in the auto-intoxications this is greatly increased. Brunon and Guerbet report in detail their observations on 15 cases of auto-intoxication, followed closely as regards this relation, and in all they found the quotient higher than normal, and up to 3.16 (some authors report it as high as 6 to 7), but as the signs of the auto-intoxication diminish, the quotient became smaller, until, when cured, the patients showed a normal quotient again.

A New Microchemical Test for Mucus in the Feces.—HECHT (*Wien. klin. Woch.*, 1908, xxi, 1554) employs a 2 per cent. solution of brilliant green and a 1 per cent. solution of neutral red. These are mixed in equal parts. The resultant solution is about the color of Ehrlich's triacid stain. A small drop of the mixed stain is added to a bit of fecal material on a slide, mixed well, and covered with a cover-glass. The preparation is pressed with filter paper to remove the excess of stain, and is then ready for examination. The stool is stained diffusely green, the fluid being red from withdrawal of the green. The mucus is precipitated and stained a brilliant red; fibrin is stained bluish green, likewise the protoplasm of cells, and especially the cellular elements, which have imbibed alkaline soaps. In addition to mucus, bacteria, cell membranes of vegetable cells, and nuclei of cells are stained red. Clumps of bacteria can, however, easily be distinguished from mucus by using high magnification. Particles of mucus that are difficult to demonstrate otherwise are easily recognized by this method.

SURGERY.

UNDER THE CHARGE OF

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Drainage of the Brain Ventricles by Transplanted Bloodvessels.—PAYR (*Archiv f. klin. Chir.*, 1908, lxxxvii, 801) reports three cases operated on for internal hydrocephalus, by making a drainage path from the ventricle to the venous current by means of a transplanted bloodvessel. The essentials of the operation consist of a water-tight conduction of the cerebrospinal fluid toward the venous path, the preservation of the normal venous circulation, the prevention of a back current of blood into the ventricle, the avoidance of hemorrhage and air emboli during or after the operation, and the avoidance of infection. When a vein, as the long saphenous, is employed for the anastomotic tube, the function of the valves must be taken into account. The longitudinal sinus should be employed as the venous trunk into which the anastomosis is to be made. Failure of the operation may result from insufficient length of the transplanted segment of bloodvessel or from unsuitable quality of the vessel (phlebosclerosis, varicosities). In some cases of congenital hydrocephalus the longitudinal sinus may be absent, or it may be obliterated by inflammation or thrombosis. Severe hemorrhage may compel one to abandon the operation, or it may fail from a poor line of sutures, primary or secondary compression, or a false direction of the transplanted bloodvessel. Necrosis of this vessel may result from disturbed nutrition, or it may follow mechanical, chemical, or thermal insult. Thrombosis of the longitudinal sinus or the drainage path may occur. The transplanted vessel may be forced out of the ventricle, or softening of the brain in the region of the drainage vessel, or secondary infection, may occur. A permanent drainage of the ventricle toward the venous current is a method of treatment not only for the internal hydrocephalus, but also for the pressure on the brain. This is of especial importance for those cases in which the cause of the condition cannot be recognized or cannot be overcome. This drainage is rendered possible, probably, because the transplanted bloodvessel is an endothelial lined passage between the ventricle and the sinus. The chief dangers, infection, air emboli, and hemorrhage at the time of the operation or later, are best avoided by asepsis, measures for provisional hemostasis, and exact suturing. There must be some provision for a valve to prevent a back flow of blood into the ventricle. When the cerebrospinal fluid cannot be drained into the blood path, one must be contented with drainage into the subarachnoid space or into the soft tissues of the scalp.

The Treatment of Operative Pneumothorax in a Healthy Pleural Cavity.—LANE (*Archiv. gén. d. chir.*, 1908, ii, 335) says that a total pneumothorax from an external cause and due to a small opening in the pleura is nearly always benign, provided that the wound has not been infected. When there is a large tear of the pleura, the respiratory difficulties which follow the entrance of air vary in intensity according to the conditions of the experiment. They are not relieved by the diminution of the bleeding area, but depend upon the degree of dislocation of the mediastinum. Total pneumothorax is always borne well if it is produced slowly and carefully, and if the opposite lung functionates well. In the course of operations by the transpleural route, the employment of apparatus for negative or positive pressure seems to be difficult to carry out, while the true surgical measures are always sufficient to provide against the respiratory difficulties which follow the entrance of air into the pleural cavity. The patients do not die during the operation from pneumothorax, but from the infection of the pleura; so that it is not so much the measures to prevent pneumothorax that one should seek, as those of avoiding infection. If the pleura has become infected, one should provide against its consequence, as much as possible. The cavity should be tamponed with warm compresses and the field of operation isolated, as in operations in the abdomen. If the symptoms become alarming, the packing of the pleural cavity should not be insisted upon, nor should too much be expected of artificial respiration. It is important that the resorption of the air be accomplished quickly, to empty the cavity and eliminate the dead spaces in which the liquids can stagnate and become infected. If, in spite of the precautions taken to avoid infection, the early respiratory phenomena persist during the following days coincidently with fever, one should lose no time in draining the pleural cavity by a costal resection. It would, perhaps, be an advantage to provide irrigations also. With a good technique and rigorous asepsis, provoking the pneumothorax slowly and scientifically, watching the patient carefully, and being ready to drain on the least rise of temperature, one can always carry out an operation by the transpleural route, without having recourse to resources other than those which surgery offers, and without recourse to negative or positive atmospheric pressure.

Concerning the Anatomical Condition of Suprarenal Tissue Transplanted into the Kidney.—STOERK and HABERER (*Archiv f. klin. Chir.*, 1908, lxxxvii, 893) have further investigated the fate of suprarenal tissue embedded in the kidney. Haberer presented a paper on this subject last year, the object of which was to obtain experimental evidence concerning the question of the origin of renal tumors, which, according to the hypothesis of Grawitz, take their origin in fetal life in a portion of the suprarenal gland which becomes developed in the renal cortex; also concerning the origin of the so-called hypernephroma. In the sense of providing a suitable nourishment, a suitable method of transplantation will protect against destruction of a portion of the suprarenal gland, as well the cortical as the medullary portion. From this embedded portion there is developed, by the combination of the new-formed and old altered tissue with the continued good nourishment, a new organ, which agrees in function and structure with the physiologi-

cal suprarenal gland. In other respects it deviated in a characteristic manner from the original gland. The proliferation of the new and old cortical cells produces a histological picture which completely agrees with the so-called adenoma of the suprarenal cortex of man and animals. In no aspect do these formations agree with the histological picture of the renal tumors of Grawitz.

A Typical Fracture of the Internal Epicondyle of the Femur.—VOGEL (*Archiv f. klin. Chir.*, 1908, 1076) says that Stieda, two years ago, called attention to a new fracture, which consisted of a thin, flat piece of bone, separated from the internal condyle. It is shown by the skiagraph to remain more or less closely applied to the condyle. Its position corresponds to the lowest part of the insertion of the adductor magnus and the origin of the internal head of the gastrocnemius. Stieda thought that it was due either to a tearing off by the muscle or to direct violence. In Stieda's cases the history seemed to show that it was caused by direct violence. Vogel's two cases likewise showed the same cause, and he thinks that it is not due to muscular pull. The symptoms consist of the typical pain at the seat of fracture, swelling, ecchymosis, and limitation of movement in the joint. The most characteristic symptom in recent cases is the tenderness which is always precisely located. The skiagraph will confirm the diagnosis. The treatment up to the present time has always been non-operative. Vogel has obtained tolerably good results from the use of Bier's hot-air treatment, combined with massage and passive movements. In one case he cut down upon and removed the loose fragment. The operation is without danger, can be done in five minutes and does not open the joint, at least in the typical fracture. In two cases, following the conservative treatment, the patient experienced some disturbances afterward, and the skiagraph showed small osteophytes or exostoses, which resulted from the stripped up periosteum. These may disappear later, but they may also increase in size, so that their sharp points may give rise to greater disturbance. The patient from whom the fragment was removed by operation at the time of discharge did not complain either of pain or any objective abnormality. The prognosis of the injury is, in general, good, but it should take into consideration the possibilities of the late results of conservative treatment. It is of course possible for consolidation to fail and the fragment to become absorbed. It may require a long time before the patient is able to work. With the removal of the fragment, the treatment will surely be more brief and the guarantee of complete recovery may be more complete than with the conservative method.

Osteoplastic Compensation after Resection of the Lower Jaw.—RYDYGIER (*Zentralbl. f. Chir.*, 1908, xxxv, 1321) does not believe that the filling in of the defect in the lower jaw left by resection can be done as well by a piece of rib carried upward in a skin and fascial flap as by a similar flap carrying a piece of the nearer lying clavicle. He has been doing the latter operation for sixteen years. A skin flap is formed over the clavicle, reaching two fingers' breadth below its lower border and wide enough to suit the deficiency in the jaw. The flap is freed only up to the lower edge of the clavicle, but it is not separated from the anterior surface of the bone. Considerable care will be necessary to avoid

this separation, as the subcutaneous tissue is very loose. The anterior half of the clavicle is then separated from the rest of the bone and lifted with the flap, which has an attachment at its base above. The lower loose portion is then wrapped around the under surface of the separated piece of bone, and eight days are allowed to pass for the development of firm adhesions between the bone piece and its enveloping flap. It can then, by means of a sufficiently long skin flap above, be transplanted into the defect in the lower jaw.

The Treatment of Biliary Lithiasis.—BENOIT (*Jour. d. méd. et d. chir.*, 1908, iii, 329) gives a *resume* of the teachings of Gilbert, Carnot, and Jomier on the medical treatment, as well as that of Mongour on the surgical treatment, of gallstones, these men representing the French school. The arthritic diathesis predisposes to gallstones. The local conditions favoring their formation are infection of the gall-bladder and relative stagnation of the bile. In women, in addition to the usual causes of bile stagnation, there is the use of corsets. Preventive medicine depends more upon hygiene than upon drugs. There is no doubt that the alkaline salts, bicarbonate of sodium in particular, will aid in keeping the bile in a fluid form. Calomel, by its cholagogue action, tends to combat the torpor of the liver, but cannot be kept up long because of its disturbing effect on the digestive tract. Hygiene is most important, and the diet should be especially lactovegetarian. Hydrotherapy in all its forms favors elimination by the skin, as well as frictions, massage, and sports not to excess. In the greater number of the cases one is justified in provoking or aiding the migration of the calculus, as by calomel and sodium sulphate, which increase the biliary flow, and by salicylate or benzoate of sodium, which are cholagogues and antiseptics. Olive oil is advised for stones in the common duct. The remarkable toleration of the biliary tract, and the good effect of therapeutic measures, will often render surgical action unnecessary. Mongour, reporting on the surgical side, said that operation should be a therapeutic exception. Those who argue for early operation, that is, on the first attack of colic, are not justified by the facts or results. Biliary lithiasis is not, exclusively, a local affection, and operation does not affect the diathesis. In spite of possible complications, lithiasis ought to be considered a benign affection, as shown by statistics from Vichy and those published by the International Congress of Insurance Companies. The operative death rate, even in the more favorable cases, is more than 2 per cent. It is greater than that if one takes into account the late postoperative accidents. Finally, operation does not insure the patient against recurrences. When the stones are in the gall-bladder, the indications, as formulated by Mongour, are as follows: Exceptionally frequent and painful cases; when the patient cannot follow a prolonged medical treatment; in infection of the gall-bladder, especially in chronic cases; in cases of general infection starting from the gall-bladder. If the stones are in the common duct, the time of operation depends upon: (1) the quality of the biliary secretion, and (2) the nature and intensity of the local or general infectious complications. Operation should be done when the bile appears in the urine, and can be deferred as long as there is only a simple jaundice.

The Prevention of Kidney Stone Recurrence.—KLEMPERER (*Deut. Zeitschr. f. Chir.*, 1908, xcv, 304) says that the recurrence of renal calculi after they have been removed by operation is well known. An abundant free flushing of the kidney and its pelvis will prevent the deposit of calculous particles. The original nucleus is of microscopic size, and its increase in volume depends upon the apposition of the urinary sediment, which is possible only in a slowly escaping or stagnating stream. The most important point in the treatment, therefore, is to administer large quantities of liquid by the mouth. The drinking of 200 or 300 c.c. of fluid, every two or three hours, and especially a large quantity before going to bed is advised. The night urine is particularly inspissated and prone to sedimentation. Still more fluid should be drunk during the night, especially by old people, who frequently get out of bed. The kind of drink is not very important, the alkaline, carbonic acid, mineral waters being preferred. Even alcoholic drinks may be taken. Obesity and heart weakness favor calculi formation. Von Örtel and Schweninger believe that much drink increases the obesity. Experience and physiological experiments, however, have shown that much fluid in an empty stomach favors emaciation, so that fat people should not drink during meals. Patients suffering from cardiac disturbances should take fluid during periods of disturbed compensation more cautiously. According to Klemperer's observations, the stones in these cases are small and round, and are passed without much difficulty. A mixed diet is preferable to a uniform one, which favors the formation of an acid urine and, therefore, an increased sediment. An alkaline reaction due to the administration of the carbonates can favor the deposit of phosphates. In his collection of kidney stones are several in which the acid nucleus is coated with a white, phosphatic layer. Patients with urate or oxalate calculi should take a moderate amount of meat with vegetables and fruits. Medicines are usually of little value. In cases with oxaluria, however, small doses of magnesium sulphate, which are excreted by the urine and can take up calcium oxalate in solution, should be given. When the alkalinity of the urine is due to infection, of more importance than diet or urinary antiseptics is the mechanical effect of flushing the kidneys or the removal of any existing obstruction.

Diffuse Septic Peritonitis Due to Appendicitis.—FOWLER (*Annals of Surgery*, 1908, xlviii, 828) says that we must look for a lowering of the high mortality rate in early operation rather than in any further development in mechanical intervention. Early postural drainage is of greater aid in preventing septic material from reaching the diaphragmatic peritoneum than in preventing further absorption after this area is once involved. The manner of instituting postural drainage matters little, provided the pelvis is sufficiently low for gravitation to take place and the patient is comfortable. Peritoneal lavage dilutes septic material, and when practised should be continued until the cavity is partially closed. Plastic lymph not removed by irrigation or by simple lifting should not be disturbed. All cases of this nature should be drained. The ideal method, in women, is by a posterior colpotomy incision, by means of a large rubber tube. Cases not drained frequently develop pus pockets and superficial wound infections. Ochsner's

treatment should be instituted after operation and Murphey's proctolysis practised. Open the abdomen by a small incision over McBurney's point, deal quickly with the primary focus, prevent evisceration, and use the greatest gentleness in handling parts.

Simultaneous Ligation of Both External Iliac Arteries for Secondary Hemorrhage Following Bilateral Ureterolithotomy.—MOSCHOWITZ (*Annals of Surgery*, 1908, xlviii, 872) reports a case in which a left-sided ureterolithotomy had been done by another surgeon June 15, 1907. Eleven days after this operation an attack of right-sided renal colic occurred, and was regarded by the surgeon in charge as an example of contralateral pain. On July 20, 1908, the patient was operated on a second time by Moschowitz. This operation consisted of a bilateral ureterolithotomy, with the removal of two calculi from the pelvic portion of each ureter, through lateral extraperitoneal incisions. The ureteral incisions were closed by interrupted iodine catgut sutures. Seven days after operation, on removal of the left rubber drainage tube, which came away easily, a tremendous hemorrhage followed immediately. A finger introduced promptly controlled the bleeding at once. Immediate operation showed a hole in the external iliac artery the size of the tip of the little finger, produced by the pressure of the tube. Accidental pulling out of the tube on the other side, after the ligation of the left artery, resulted in a similar hemorrhage on that side. The same cause was found and the same measures for its control were resorted to. All pulsation ceased below the ligature and both lower extremities became blanched. These were wrapped in cotton and the trunk and legs were slightly elevated. Yet the general condition was fair, and on the evening of the same day the toes were warm, of a delicate pink color, and capable of slight active motion. On the following day slight femoral pulsation was to be felt, and on the third day an occasional flutter in the dorsalis pedis artery. Thereafter recovery was entirely uneventful. Ten weeks after operation, the incisions were firmly healed; there was no hernia; pulsation could be felt in both femorals and dorsalis pedis arteries, although somewhat smaller than in the normal. This is the first case reported of simultaneous ligation of both external iliacs, successful or otherwise.

THERAPEUTICS.

UNDER THE CHARGE OF

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Principles of the Dietetic Treatment of Severe Diabetes.—KOLISCH (*Zeit. f. Phys. und Diät-Therapie*, 1908, iii, 150; iv, 212) discusses the etiology and pathology of diabetes and considers the dietetic treat-

ment of severe cases. He considers it most important to reduce the diet so that it will supply the smallest possible number of calories necessary for the maintenance of the body weight. He believes that the number of calories needed for a diabetic patient is less than for a normal person, if the diet is properly chosen. Thus, he has found that a diabetic will not lose weight, but frequently increase in weight and strength, on a diet which is chiefly vegetarian. The number of calories per kilogram of weight which he considers necessary is about 20. A second principle is that the proteids should be reduced in amount. He thinks that proteids when taken in large quantities are capable of breaking down the body cells and of causing an increased glycosuria. The third principle is that the diet should contain the maximum amount of carbohydrates that can be used without increasing the glycosuria. This is effected by a reduction of the proteids, since it is known that a diminution of the proteid in the diet makes possible an increase of the carbohydrates, and vice versa.

Experimental proof of this teaching was given in the report of a series of severe cases by Kolisch and Sheeman-Lequerc. Each of the patients was put on a moderate standard diet until the output of nitrogen and the glycosuria became constant. Then the amount of carbohydrates was increased and the proteids diminished, the value in calories remaining equal, with the result that the glycosuria did not increase and in some cases diminished considerably. When the carbohydrates were given in large excess of calories, as compared with the amount of proteid withdrawn, the glycosuria increased considerably, but on a return to the standard diet the level of the glycosuria fell below the level of the first standard period. The principles advanced by Kolisch will explain the results obtained by the milk, buttermilk, rice, oatmeal, and potato treatment of diabetes. These diets have the common characteristics of being of relatively low caloric value, of containing little proteid, and, with exception of the milk, the proteid is of vegetable origin. The carbohydrate content of these diets is relatively high, and, moreover, the proteids and carbohydrates are given constantly in the same form which makes them better tolerated by diabetic patients. Kolisch has used a vegetable diet for ten years. For the average case, about 1500 calories per day are necessary. He claims the main advantages are as follows: (1) The largest possible amount of carbohydrates can be taken because of the low proteid content. (2) The proteid is vegetable proteid, and therefore less harmful. (3) Vegetables contain relatively a large amount of alkalis which are of service in preventing or in treating acidosis when it exists. (4) A vegetable diet helps peristalsis. Small quantities of egg albumin and fat are added to the vegetable diet. He gives the following standard diet, to which gradually increasing amounts of carbohydrates may be added as the glycosuria diminishes: For breakfast: Cup of coffee with 60 gms. whipped cream, white of one hard-boiled egg. At noon: (Karfiol) Milk, butter, cabbage with bacon, white of one egg, salad (endive, lettuce, cabbage) with 20 gms. oil, one apple. For supper: Tea or coffee with 60 gms. whipped cream, mushrooms with fat, white of one egg, salad, or beans with butter, one apple.

The Influence of Prolonged Digitalis Treatment on the Normal and Diseased Heart.—CLOETTA (*Therapie der Gegenwart*, 1908, x, 437) relates

the results of some very interesting experiments with the prolonged use of digitalis on animals. He treated healthy dogs continuously for two years with gradually increasing doses of digitalis given subcutaneously. None of these dogs showed any cardiac hypertrophy or other anatomical or functional changes in the circulatory organs. His results showed that a functionally weak heart was not made strong, except during the period of taking the drug. The most interesting results were obtained in the animals in which he induced an acute endocarditis of the aortic valves and produced an aortic insufficiency. Some of these animals were then treated with digitalis, and after several months their hearts were compared with the control animals. These experiments seemed to indicate a decidedly beneficial influence from the use of digitalis upon the late results of an acute endocarditis. This influence was shown not only by the anatomical differences, but also by the functional capacity during life in the two sets of animals. The hearts of the digitalis animals were only 30 per cent. larger than normal, while in the untreated animals the hypertrophy was 80 per cent. above the normal. The fact that the lesion induced was an aortic insufficiency makes these results particularly interesting. Cloetta believes that the use of digitalis kept the hypertrophy within bounds and maintained the circulation in a more normal manner in the digitalis animals. It is needless to say there was no effect upon the valvular defect. Cloetta believes that in acute endocarditis the heart is apt to be irritable and does too much or too little work, that the good effects of the digitalis are due to its soothing and quieting action, and that there will result less dilatation and, in consequence, less subsequent hypertrophy. Several of the untreated animals died with dropsy in less than six months, while none of the treated animals showed any signs of heart trouble. From these results Cloetta is convinced that digitalis is bound to have a favorable effect upon recent endocarditis. He advises that since digitalis managed carefully is harmless, it should certainly be tried, and he believes that if this is done early, there will be less need of the drug in later years.

The Treatment of Arteriosclerosis.—SHEFFER (*Arch. gén. de méd.*, vi, 337) affirms that the generally accepted belief that arterial hypertension is the cause of the vascular lesions of arteriosclerosis cannot be considered absolute. He holds this belief because a marked arteriosclerosis may exist without hypertension. Danin found hypertension in 70 per cent. of his cases, Grödel in 65 per cent., and Strasburger in 46 per cent. Sheffer himself found hypertension in 60 per cent. Lancereaux, Hayem, and Chantemesse consider that hypertension is the result, and not the cause of arteriosclerosis. In either case the arteriosclerosis is due to the same causes, the injurious effect of poisons or toxins in the circulating blood. These poisons produce either vasoconstrictions or degenerative changes directly in the walls of the arteries. A necessary factor is an hereditary or individual predisposition. Sheffer believes that this predisposition consists of a defect in the metabolism of silicates. Gaube, Robin, and Binet have shown that the silicates are important in the economy. The quantity of silica in the muscles of an average man is about 6 gm., or twice as much as the amount of iron in the blood. Decene believes that the silicates prevent the deposition of lime salts. In the treatment of arteriosclerosis Sheffer advises

the use of sodium silicate, which is a thick, syrupy liquid, with a disagreeable taste, and therefore should be given well diluted. The average daily dose is 1.5 to 3 grams. It may be employed for any length of time, although it is better to suspend its use from time to time. No digestive disturbances have been observed from its use; in fact, the digestive function seems to be improved. The arterial tension is lowered and remains at a constant and lower level after the drug has been used for from two to four weeks. The symptoms of cerebral arteriosclerosis, headache, and dizziness disappear very rapidly, and albuminuria diminishes or may entirely disappear. This result is also obtained in cases in which there is no increase of tension. A longer time is required to relieve dyspnoea or angina pectoris. In every case the general symptoms are improved and the patients feel stronger. The best results are obtained in the presclerotic stage. Sheffer also claims good results with this medication in the treatment of arthritis deformans.

The Treatment of Syphilis.—WECHSELMANN (*Fol. Therap.*, 1908, iv, 122) reviews the treatment of syphilis which has been placed on a more scientific basis by the discovery of *Spirochæta pallida* and by experimental investigation. Various investigations seem to prove that mercury acts directly upon the syphilitic virus. Neisser was able to diminish the eruption of the disease in apes inoculated with syphilis if mercury was introduced into the animal simultaneously with or soon after the inoculation. Atoxyl seems to act in the same way, but the doses required are frequently too large to be entirely safe. Moreover, atoxyl is not nearly so efficacious as mercury, and the effect of atoxyl on the late stages of syphilis is still unknown. Iodine appears to act on the tissues as an absorbing agent and only slightly on the syphilitic virus. Since spirochetes have been found in gummas and the infectious nature of these gummas has been established, the use of mercury in the tertiary stage of syphilis is justified. Wechselmann believes that the internal administration of soluble salts of mercury is weak in action, while the injection of insoluble salts has a much more energetic healing effect. However, the injection treatment frequently causes severe toxic symptoms and sometimes fatal results. He believes that the inunction method is just as potent and less dangerous. When the inunction method is inapplicable, the injection treatment is indicated. For this purpose mercury salicylate and thymolacet are the most suitable salts. The average dose is 0.1 gram every eighth day. Gray oil acts more energetically, but is more painful and has a greater tendency to toxicity. It should be used only in the rarer cases which resist ordinary treatment. Sterilized paraffin oil, olive oil, or vasenol may be employed as vehicles to convey the mercury. The injections should be made into the upper and outer quadrant of the buttock, where the veins are few in number. The injection of soluble salts is only suitable for the milder cases or for intermittent treatment. They are apt to be more painful. He recommends for internal medication mercurous tannate (0.1 gram thrice daily in pill form) or yellow mercurous iodide (0.01 to 0.02 gram thrice daily in pill form). Mergal in doses of three to six capsules daily is also valuable. Mergal is mercury cholate with tannin albuminate, and seems to cause no colic or renal irritation even when given for a prolonged period. Its action is mild and should be used

when vigorous treatment does not appear essential. In those malignant cases of syphilis which tend to cause rapidly destructive lesions and resist ordinary treatment, Wechselmann believes that calomel is the best remedy. It should be injected in doses of 0.1 gram, and the risk of poisoning must be assumed. In some isolated cases, the use of atoxyl has increased the patient's strength and weight so that he could tolerate a course of mercury treatment. Wechselmann says that a rapid method for securing the action of iodine is by the injection of iodopin. For several days 10 to 20 grams of warmed 25 per cent. iodopin solution is injected under the skin of the back or buttock.

The Use of Arsacetin in the Treatment of Syphilis.—NEISSER (*Deut. med. Woch.*, 1908, xxxv) believes that none of the newer remedies will replace mercury in the treatment of syphilis, but that they will often be of value to supplement the action of mercury or they may be used when mercury is not tolerated. He speaks of both the curative and prophylactic use of atoxyl, and then proceeds concerning the new arsenical preparation arsacetin introduced by Ehrlich. He believes that, of the two, arsacetin is much less apt to cause toxic symptoms and that the curative effects seem to be greater. The solution does not decompose, and can be sterilized. The initial dose should be 0.05 to 0.1 gram, which is gradually increased. Degenerative changes of the heart or kidney increase the liability to the production of toxic symptoms. In general arsacetin should not be given when there is myocarditis, and if the kidneys are insufficient, the urine must be frequently examined and the drug stopped if there are signs of kidney irritation. Some cases of kidney disease (possibly when due to the syphilitic virus) are benefited by its use. Neisser thinks that the treatment should be begun as soon as the diagnosis is made, either by finding the spirochetes or by the serum reaction. He believes that a combination of the arsacetin and the mercurial treatment will secure the quickest and best results. Arsacetin (0.6 to 0.75 gram) is injected on two succeeding days, and after an interval of four days this double injection is repeated. The entire treatment takes ten weeks, and 12 to 14 grams of arsacetin are used in all. Neisser used a 10 to 15 per cent. solution, which caused neither infiltration nor abscess. Mercury was given by inunction or by injection of gray oil. In some cases he also gave arsacetin 0.12 gram a day by mouth, but thinks that this method and dosage have not been sufficiently established.

Active Immunization by Subcutaneous Injections of Living Typhoid Bacilli in Typhoid Fever.—PESCAROLO and QUADRONE (*Zentralbl. f. inn. Med.*, 1908, xl, 989) present a preliminary report of their results with the use of subcutaneous injections of living typhoid bacilli. Their conclusions are as follows: (1) In typhoid fever, bacteriotherapy has a real value chiefly because of a stimulating action on the production of immunizing substances in the blood. (2) It is entirely harmless and causes only transitory symptoms of a local or general reaction. (3) It is of especial value in cases of typhoid septicaemia, when the symptoms of a general infection are the chief characteristics. (4) The injections should be made early but not before the bacteriological diagnosis is made. The bacteriological diagnosis is made by the blood culture method.

PEDIATRICS.

UNDER THE CHARGE OF

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The Treatment of Otitis Media Complicating Scarlet Fever and Measles.—E. P. FOWLER (*Amer. Jour. Obst.*, 1908, lviii, 530) states that acute otitis media occurs probably in 20 per cent. of scarlet fever cases and in 5 per cent. of measles; the supervention of chronic suppurative otitis media he considers usually the result of neglect except in the tuberculous and other weak patients, in whom it may be chronic from the outset. Adenoids and tonsillar hypertrophy are a very important cause for the high percentage of cases of ear disease in measles and scarlatina; these conditions, therefore, should be corrected before children are taken with the exanthems. The preventive treatment is to care for the infections by keeping the room temperature at from 60° to 65°, the air moist so that the respiratory mucous membranes may not be irritated and the patient may not take cold in addition to the disease. Measles patients should be kept in bed for ten days, scarlet fever patients for twenty-eight days. To the neck should be applied a moist compress covered with rubber tissue. The mouth, nose, throat, and eyes should be kept clean, the nose being frequently cleaned of its secretions, one nostril at a time being compressed. The Politzer bag should be used gently, borovaseilin for the coryza and sneezing, cocaine or weak adrenalin tampons for the catarrh. The throat should be swabbed regularly. These measures will prevent many ear and throat complications.

Should otitis develop, the bowels must at once be opened, diaphoresis produced, and the ear canal irrigated with either hot bichloride, boric acid or normal salt solutions, using two quarts of fluid every two hours; a suction ball instrument is the best instrument to use. As soon as pus is diagnosticated, an incision must be made through the tympanic membrane. Doubtful cases should always be incised after two to three days, also cases with slight bulging of the tympanic membrane with tenderness over the mastoid. In the presence of streptococci and mastoid tenderness, the mastoid should at once be opened to prevent meningeal involvement. Drainage must be resorted to and suction used at the dressings to bring all purulent matter to the surface.

Paralysis in Infancy due to Gastro-intestinal Intoxication.—H. LONGO (*Ann. de chir. et d'orth.*, 1908, xxi, 165) reports the case of a girl, aged four and one-half years, who had been twice paralyzed in the short course of her life. She was perfectly well and had developed normally until her ninth month, when an enterocolitis made her ill for ten days. This left her with constipation, for which enemas were employed. At thirteen months, while apparently in the best of health, she fell over and could not be made to stand again. Fever and drowsiness existed, but no vomiting or convulsions. A purge, milk diet,

and cold to the head caused a disappearance of the symptoms. A left-sided paralysis was noted, the mouth being drawn to the right. Absolutely all signs of this paralysis had disappeared by the eighteenth month. At three years the child again had an intestinal infection: constant slight fever, foetid diarrhoea. This continued for a long time, the diarrhoea alternating with a persistent constipation; the tongue was constantly coated. Suddenly one day she again fell over and had a slight convulsive seizure, followed by somnolence, fever, and irritability, and a complete right-sided hemiplegia. Purgatives and enemas soon cleared up the patient's mental state, but the paralysis and aphasia persisted. After several weeks the paralysis disappeared and speech returned. The urine during the entire attack remained abundant, and contained no albumin. Four months after the onset not a sign of paralysis could be observed. In Longo's opinion both paralytic attacks were due to an intestinal intoxication. He excludes hysteria chiefly because of the age of the child; the functional nature of the condition is ably defended.

Hemorrhoids in Infants.—After reviewing the scanty literature on this subject, D. G. ZESAS (*Arch. gén. de chir.*, 1908, ii, 355) reports such a case in a child aged three and one-half years. He finds that heredity is of importance in the development of hemorrhoids in infants. Any condition interfering with the circulation, just as in adults, may induce hemorrhoids; constipation plays a very important part. Other causes are tumors within the abdominal cavity, enlarged mesenteric glands, diseases of the liver, etc. Infections about the anus may cause a phlebitis, and a secondary hemorrhoidal state may result. Phimosis has been followed by hemorrhoids. Zesas' patient had been rachitic since birth; he had marked bleeding from the anus with each stool since his sixth month, and of late discharged blood even without stool. The cause of the condition has not been recognized. A Whitehead operation was performed and the patient recovered completely. The hemorrhoids may be in the form of an angioma or a simple varicosity. Zesas states that there should be no difficulty in differentiating it from rectal polyps, the only condition with which it might be confounded. The treatment should always be operative; recurrences have never been noted.

Artificial Infant Feeding.—PISEK (*Amer. Jour. Obst.* 1908, lviii, 694) summarizes this important subject for the general practitioner in the following sentences: All infants require a liberal supply of fats and carbohydrates to supply energy and heat, and a small supply of proteids and mineral matter to replace the daily loss. If these are supplied, the infant can get along for considerable periods of time without showing bad effects, but successful development and growth cannot take place. For proper growth, a liberal supply of proteids and mineral salts in addition to the quantity needed to replace waste is absolutely essential, for while gain in weight may result from the conversion of fats and carbohydrates of the food into body fat, growth or the formation of blood and tissue cannot occur unless there is more proteid and mineral matter in the food than is needed to replace loss. The development of the infant rests on the proteid supply. A portion of the proteids of

the food for healthy infants must be in the form of milk, as this is changed in the stomach, by the gastric secretions, into a semisolid food which is the forerunner of solid food. All infants conform to the general laws of nutrition, and no infant is a law unto itself except in nonessentials and in its preferences for different forms of food. Varying the form in which the food elements are presented has much to do with success in feeding, and feeding in difficult cases depends absolutely upon it. Infants differ to a marked degree in capacity for digesting and assimilating food. Some will be able to thrive and grow on a quantity of food on which other infants will not much more than hold their own. As each element of the food performs a special function in nutrition, it is important to know approximately the composition of all feeding mixtures employed, for excess or deficiency of one or all of the ingredients is attended with harmful results, if continued for any length of time. The raw materials for making up food for infants under all conditions consist almost exclusively of cow's milk, milk sugar, cane sugar, and the cereals. The successful infant feeder is the one who can combine these substances in such a manner as to meet the peculiarities of each particular infant.

Tabes and Juvenile General Paralysis through Acquired Syphilis.—APERT, LEVY-FRAENKEL, and MENARD (*Arch. de méd. des enfants*, 1908, xi, 477) report the case of a girl, aged fifteen years, whose father contracted syphilis when she was two years old; immediately after acquiring it he infected his wife. Both of them had initial lesions and a number of secondary manifestations, and treatment in the form of van Swieten's fluid was carried out but a short time. The father developed tabes six years later, and died of general paralysis twelve years after the onset of the syphilitic infection. The mother is living; she has tabes also, developing it about the same time as her husband. An older brother is living and well. The patient slept with her parents (between them) at the time they had their initial lesions. The child developed a purulent discharge, had ardor urinæ, and lost much flesh. She also had a cutaneous eruption some weeks later. At the age of fourteen there was headache, vomiting, fever, and coma, all of which disappeared after some days. Her present illness was ushered in by an epileptiform convulsion, during which she had conjugate deviation, nystagmus, vomiting, positive Babinski, and absence of knee-jerks. The latter persisted after the attack; there is also now incontinence of urine and attacks of vomiting. After recovering from the acute attack the child remained quiet, melancholy, and somewhat queer. The pupils became unequal, the Argyll-Robertson sign developed, and later also an iridochoroiditis. A trophic ulcer has made its appearance on the outer side of the foot. Romberg's sign is positive and the gait somewhat characteristic of tabes dorsalis. There is no disturbance of speech or writing. The mental traits of general paralysis have become more and more pronounced. There is, however, no tremor, speech- or writing-disturbance. Antisyphilitic treatment has been of no avail.

OBSTETRICS.

UNDER THE CHARGE OF

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Elongation of the Cervix Uteri Complicating Labor.—ROUVIER (*L'Obstétrique*, August, 1908) draws attention to this condition as a complication of labor. He has observed 20 cases, and finds the cause to be some obstruction in the circulation of the uterus, arising during labor. In primiparous patients this condition arises when the head is pressed deeply down into the pelvis and remains there some time with full dilatation. In extreme cases the enlargement resembles a polyp, and is usually upon one side of the cervix only. In multiparous patients one might expect this condition more frequently, because of the progressive increase in the size of the fœtus. Statistics, however, do not bear out this hypothesis; most of these cases occur when the fœtus is normal in weight. The condition has been observed in premature labor. In multiparæ the important factor in producing this complication is absence of flexion in the fœtal head, or the developing of some unusual presentation. In twin pregnancy, when dilatation proceeds very slowly, this condition develops, but never to an extreme degree. In some primiparæ it has been observed accompanied by pelvic deformity. In most cases the tumor resembles somewhat in shape the mouthpiece of a flute. When swelling is extreme the tumor may be present in the vagina. In diagnosis it is to be distinguished from uterine polyp attached to the body of the womb. The elongation resembling a polyp is never present excepting during labor, while a chronic condition of polypoid degeneration may be found indefinitely. This enlargement of the uterine neck usually disappears spontaneously after labor, while a uterine polyp would remain. The condition may also be confused with cystocele or rectocele, which is greatly exaggerated at the moment when the fœtus is expelled. It may also resemble a vascular polyp, for which the operation of extirpation may be undertaken. Fibroid tumor developing from the neck of the uterus should not be mistaken for this condition, if the pedicle of the tumor can be recognized. If the placenta should present in this position, it would become more or less separated during labor, resulting in hemorrhage, which should lead to diagnosis. The prognosis of unilateral œdematous enlargement of the cervix varies in accordance with a number of factors. When a diagnosis is made early and labor is conducted in accordance with the symptoms which develop, the prognosis is favorable. The spontaneous resolution of the tumor during labor is also advantageous. In rare cases the separation and expulsion of the tumor before the fœtus may be distinctly favorable. The formation of a thrombus or hematoma is an undesirable complication. This may rupture during labor or as late as the fourth or fifth day after. So far as the fœtus is concerned, it is not exposed to additional risks so long as the membranes are unruptured. After the amniotic liquid escapes the cervix may increase the pressure upon the fœtal head.

In dealing with these cases one must not expect the spontaneous disappearance of the tumor during labor. In premature labor with the membranes unruptured, interference should be avoided. The patient should be kept at rest and given sedatives. After the rupture of the membranes, especially at term, the case should be brought to an end. The occiput should be rotated anteriorly, if possible, and the swollen portion of the cervix pushed upward and released from pressure. It is occasionally necessary to make small multiple incisions into the cervix to release imprisoned blood and serum. When the pelvis is normal and labor delays, the child may be extracted with the forceps. If pelvic deformity of moderate degree is present, a better result is usually obtained by version. In the puerperal period this condition usually disappears from the ninth to the thirteenth day. Should the tumor remain it may be finally removed.

Perforative Appendicitis Complicating Pregnancy.—BABLER (*Jour. Amer. Med. Assoc.*, October 17, 1908) reports his collection of 103 cases of perforative appendicitis complicating pregnancy. The etiology of the disorder in pregnancy does not differ from that in non-pregnant patients. Three-fourths of the cases develop after the third month of pregnancy. Perforation occurred in 44.6 per cent. of cases. Portal infection rarely follows. The uterus may become infected through the peritoneum, through the lymph and bloodvessels, or through adhesions from the abscess wall to the pelvic organs. In many cases the pregnant uterus forms a part of the abscess wall. Rupture of the abscess follows contraction of the uterus and expulsion of the foetus. In some cases abscess of the appendix may form an obstacle to delivery. Diagnosis is usually made without difficulty, although in some cases ruptured tubal gestation may be confused with appendicitis. When perforation occurs, the mother's mortality averages 48.5 per cent., the foetal mortality 66 per cent. In the 103 perforative cases collected, operation was performed in 89, followed by abortion in 37; 36 mothers died. There were 14 perforative cases treated medically, all of which died; 10 of these aborted, and in 10 the child died in utero, making a maternal mortality of 100 per cent. and an infant mortality of 75 per cent. Of the 104 non-perforative cases, 50 were operated upon, 7 aborted, one mother died. Of the 54 not operated upon, 6 aborted, 4 mothers died. During the first ten days of the puerperal period 28 cases of appendicitis were collected, of which, 18 were perforative; 12 of these women were operated upon, with a mortality of 33.3 per cent.; 2 of the 6 not operated upon recovered by accident: the pus burrowed into the rectum. Nine cases were non-perforative, all of which recovered, whether treated by operation or not.

So far as treatment is concerned, these statistics strikingly emphasize the fact that operation offers the only hope of success. Operation must be done as early as possible. With perforation and localized abscess, incision and free drainage are indicated. If possible, the uterus should not be emptied before the operation, lest the diminution in its size rupture the wall of the abscess, causing pus to enter the general peritoneal cavity. If the patient has general peritonitis, incision and drainage, without disturbing the pregnancy, are indicated in early gestation. When the patient is near term the operator must decide between Cesarean section

or forcible extraction of the child followed by abdominal incision and drainage. The treatment of suppurative peritonitis is indicated in a general way.

Babler reports the case of a multipara six months advanced, who during pregnancy had frequent pain in the right lower abdomen. This increased and fever developed with great tenderness over the appendix. The cervix was slightly dilated. The foetal heart sounds were normal. The patient was brought some distance to a hospital, and upon making an incision over the area of dullness a quart of offensive pus was evacuated. The wall of the uterus formed a part of the abscess wall. The appendix could be felt near the ribs, curled on itself, perforated, containing a fecal concretion, which was so firmly adherent and so high in the abdomen that it was possible to remove only the distal, free portion. Rubber tubes were inserted for drainage, and gauze drains were placed between the abdominal wall and the uterus, so that the general peritoneal cavity might be protected if labor developed. Silkworm-gut sutures were placed in the upper and lower angles of the incision as a precaution. Two days after operation labor pains developed and a six months' foetus was expelled. The patient made a gradual recovery, with a temperature reaching as high as 104° on several occasions. When the drains were removed the wound surface was found covered with a necrotic membrane. The general peritoneal cavity was walled off, and under irrigation of the wound twice daily the patient's temperature fell. She afterward developed phlebitis in the left thigh. Her final recovery was complete.

Perforation of the Uterus with Injury to the Intestine.—SSADOWSKI (*Zentralbl. f. Gynäk.*, No. 41, 1908) reports the following interesting case: The patient summoned a physician for profuse hemorrhage, occurring one month after an abortion. It was supposed that remnants of the ovum remained, and dilatation and curetting was performed. As nothing was removed by the curette, the placental forceps was inserted and brought away what was described as a mass of soft tissue. This was cut off and found to be the intestine. Consultation was immediately summoned and the patient transferred to hospital. The original curetting was performed in the patient's lodging, with the assistance of a midwife only, although the patient was placed across the bed and a speculum used. On admission to the hospital the patient had a normal pulse and temperature, although the pulse was weak. The abdomen was slightly distended and there was moderate hemorrhage from the vagina of dark blood. A piece of small intestine between 2 and 3 cm. long was hanging from the vagina. This could be traced to the uterus, which was found slightly enlarged and anteverted, with an elastic tumor on the left side. The abdomen was opened as soon as possible and the omentum found greatly injected. There was dark fluid blood in the abdominal cavity, mixed with masses of feces and having a strong fecal odor. The intestine was much distended. A rent in the uterus in its anterior wall showed where the instrument had passed through, and where a mass of intestine had been grasped and torn from its mesentery. There was an ovarian cyst as large as a fist on the left of the uterus. The mesentery was examined, and that which had been injured was removed. The ends of the intestine were freshened and brought together. A tear in the cecum

near the ileocecal valve was closed by suture. The uterus was amputated at the cerxix, the cervix cauterized, and the ovarian cyst removed. As the abdomen was considered infected from feces, the abdominal incision was left open. Gauze tampons were inserted wherever necessary to stop the oozing from the mesentery and provide drainage. For five days after the operation the patient had considerable fever and a pulse from 120 to 130. On the fourth day the bowels moved spontaneously and the patient had diarrhœa for a few days. On the forty-ninth day after operation the patient left the hospital with an abdominal fistula about one inch in depth. She returned afterward for outpatient treatment until she completely recovered.

GYNECOLOGY.

UNDER THE CHARGE OF

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Ultimate Results Obtained from Surgical, in Comparison with Medical, Treatment in Certain Ovarian Diseases and in all Ovarian Neuroses.—HODGES (*Virginia Med. Semi-Monthly*, 1908, xiii, 222) believes too little time and skill are usually extended by both physicians and surgeons in the proper diagnosis of cases of ovarian disease and ovarian neuroses. Critical consideration is required, not only of the special features of each case and the particular existing pathological condition, but also of the individual temperament in order to reach a correct diagnosis. The systemic condition of the patient should receive first consideration, inasmuch as the removal of a single pelvic abnormality does not often effect a cure. Meddlesome pelvic interference in the treatment of these cases is to be condemned. Certain ovarian diseases and most ovarian neuroses do not usually require operative measures. Frequently operations on this organ are too radical and are performed before medical measures have been given a full and fair trial. Oftentimes by such operations an anatomical but not a physical and psychological cure is produced. Hodges offers a plea for harmonious coöperation between the surgeon and the physician in the treatment of such patients.

Primary Carcinoma of the Fallopian Tube.—GEMMELL (*Jour. Obst., and Gyn. Brit. Empire*, 1908, xiv, 31), in reporting a case of primary cancer of the Fallopian tube, states that cancer of that structure, either primary or secondary, is of rare occurrence, the case of Orthmann, in 1888, being the first one reported of the primary variety. In 90 cases of hysterectomy for cancer of the uterus the appendages were found involved secondarily in three instances and in 12 cases of ovariectomy for cancer of the ovary no instance of involvement of the tube was noted. Gemmell believes that a predisposition to cancer of the tube lies in inflammatory changes and that a coincident papillomatous growth of

the tubal mucosa paves the way for the change to malignancy. The occurrence of the disease in the middle and external portions of the tube indicates that it is a sequel to inflammatory trouble. Macroscopically it is difficult to distinguish between exuberant inflammatory product and newgrowth, and the aid of the microscope is necessary in deciding this point. The disease is generally unilateral and commonly limited in area. The clinical picture is usually that of a woman, aged about forty-five years, who has suffered from long-standing pelvic inflammatory troubles, and with some recent pelvic pain, with vaginal discharges, often profuse, sanious or watery, and some abdominal swelling. The pelvic tumor present rarely reaches above the pubes, and ascites is not always present. Recurrence and metastases are said to be rapid and fatal, yet Boxall recorded a case of carcinoma of the tube, secondary to carcinoma in the ovary, in which there was no recurrence five years later.

Late Recurrence of Mixed Ovarian Cysts in Spite of Extirpation.—VINCENT (*Ann. de gyn. et d'obst.*, 1908, v, 478) reports three cases in which he had extirpated ovarian tumors of a mixed character, that is, solid and cystic, and had been surprised to note that the return of the growths, malignant in nature, was delayed from two to nine years. Vincent suggests that the exposure of the involved tissues to air has an effect nearly as salutary as to peritoneal tuberculosis.

Gynecological Massage in the Treatment of Plastic Infiltrations and of Pelvic Exudates.—BOURCART (*Ann. d. gyn. et d'obst.*, 1908, v, 449) has used massage twenty years in his gynecological work, and concludes that massage belongs to the medical treatment and will give excellent results, especially if used reasonably and prudently and with a good technique. It should not be employed exclusively. He warns against its use in the active stages of pelvic infections, and suggests that bimanual massage be not employed in inflammatory condition of the appendages.

Infection of Operative Wounds by Malignant Disease.—I. S. STONE (*Jour. Amer. Med. Assoc.*, 1908, li, 1748) reports a case in which carcinoma or sarcoma very rapidly manifested itself in the sides of the abdominal wound a few weeks after a section had been made for cancer or sarcoma of the pelvic structures, following vaginal hysterectomy by two years. He recommends careful protection of the operation field against malignant infection.

The Principles upon which the Success of Surgical Treatment of Retro-displacements of the Uterus Depends.—R. C. COFFEY (*Surg., Gyn., and Obst.*, 1908, vii, 383) recommends an operation consisting of plications of the round ligaments and adjacent parts of the broad ligaments on to the anterior surface of the body of the uterus for the relief of retrodisplacements of that organ, and bases it upon the following principles: (1) The general scheme of nature is to hang all abdominal organs by peritoneal ligaments; (2) these ligaments are strong enough to hold several times the weight of the organs they are intended to support and notwithstanding the fact that the normal resiliency of the various organs probably aids materially the peritoneal ligaments to determine the position of the organs; (3) the peritoneum is loosely attached to

the abdominal walls, being firmly fixed only at the diaphragm, thus permitting displacements of viscera in degrees varying according to the distance from the diaphragm; (4) the peritoneum is ideally adapted for making new ligaments, inasmuch as when two peritoneal surfaces are brought together and held firmly in an aseptic state they adhere, blend, and obliterate, and the contiguous surfaces lose their endothelial covering and become continuous at the point of peritoneal union; (5) that muscle fibers are found only where intermittent motion is needed; (6) the uterus is partly abdominal and partly extraperitoneal, its abdominal ligaments (broad) being attached near its middle, thus giving it a pivotal hanging with the heavy end above the pivot; (7) muscular ligaments act independently of the peritoneum and cannot be made to adhere permanently to its connective-tissue side; (8) a large amount of connective tissue exists near the round ligament, making folding of this ligament with the broad ligament advisable to add strength; (9) ventrosuspension or ventrofixation of the uterus makes useless the round ligaments. Coffey insists that the ideal operation for retrodisplacements of the uterus consists in some form of operation which shortens the anterior fold of the broad ligament, at the same time temporarily utilizes the round ligament for its accompanying connective tissue, but which uses absorbable sutures and thus makes provision for complete recovery of the position and function of the round ligaments as soon as the sutures are absorbed.

Removal of an Ovarian Dermoid Cyst Complicating Pregnancy and without Disturbing the Pregnancy.—STROTHER (*Virginia Med. Semi-Monthly*, 1908, xiii, 259) relates a case of dermoid cyst of the ovary complicating pregnancy of three months. The tumor was removed by abdominal section and the pregnancy was not interrupted.

Early Sitting Up and Rising after Laparotomy.—An editorial (*Lancet*, 1908, i, 1225) comments on the contrast between the old plan of keeping laparotomy patients in bed four weeks after operation, and the new one of allowing such patients to sit up in one day. Ries, of Chicago, was the pioneer of the latter plea, he having employed it for six years, and Boldt for a shorter period of time. Boldt has brought the matter to the profession by his writings. In England, Chandler has employed it in 200 cases. He applies a single broad band of zinc oxide plaster, reaching from the umbilicus to the pubes, after closing the abdomen. After recovery from the effects of the anesthetic the patients were kept, by means of a bed-rest, in a sitting posture for twelve hours and then allowed to change to lying and sitting positions as they wish. On the third or fourth day they sit in a chair and all walk on the fifth day after operation, leaving the hospital well and strong from the tenth to the fourteenth day.

The Causes of Inversion of the Uterus.—ATHILL (*Brit. Med. Jour.*, 1908, i, 1224) believes most cases of inversion of the uterus do not occur in the puerperium as generally believed. He reports cases due to the presence of sessile tumors attached to the fundus and efforts at expulsion from the uterus pulled down and inverted the fundus uteri. He also believes that in puerperal cases inversion is due to attachment of the placenta to the fundus uteri.

OTOLOGY.

UNDER THE CHARGE OF

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Local Anesthesia in Otology and Rhinology.—HAYMANN (*Zentralbl. f. Ohrenheilk.*, 1908, vi, 203), in the general consideration of the subject, defines the uses and limitations of local anesthesia, both as to the means employed and the method of application, in the former drawing comparisons between cocaine, which it is desirable to replace by a less dangerous drug possessing equal anesthetic power, and alypin with one-sixth the danger of cocaine and such other of the numerous prepared substitutes as novocaine, tropacocaine, and eucaïne; in the latter distinguishing between anesthesia by superficial absorption and by infiltration, with a decided preference for the latter, because of its larger applicability and greater certainty of effect. Of the later proposed substitutes for cocaine, Haymann gives the preference to alypin and novocaine; the former for superficial application, to mucous surfaces for instance, and the latter for infiltration, both preferably combined with adrenalin which decreases the irritative effect of alypin and increases and prolongs the otherwise comparatively transitory anesthetic effect of novocaine. Aside from slight invasions of the auricle for which an ether spray affords sufficient local anesthesia, extensive incisions and dissections may be painlessly made after injections at two points: one close to the superior attachment of the auricle, and one below the lobule in the furrow between the mastoid process and the articulation; from these two puncture points the anesthetic solution may be injected subcutaneously around the attachment of the auricle and also carried inward, from the lower puncture point, along the wall of the external auditory canal.

While the intact epidermal lining of the external canal and outer coat of the drumhead afford little entrance to anesthetics locally applied, these structures possess, in part, so nearly the same nerve supply that anesthesia of the canal implies a measure of anesthesia of the drumhead.

Paracentesis of the drumhead, although a slight operation, is one demanding care in the choice of the point of invasion and in the carrying out of any extended incision; aside from the question of pain, anesthesia, therefore, is desirable. Iwanow reports a sufficient anesthesia for paracentesis, from a pad of cotton soaked in a cocaine-adrenalin solution and left for ten minutes in contact with the drumhead; other writers have attained the same end, in the same manner, with solutions of alypin of from 5 to 10 per cent., the local anesthesia being observably more rapid and more complete in proportion to the loss of the epidermal layer, an observation in accord with the use of mild corrosive agents, carbolic acid, for example, in conjunction with local anesthetics superficially applied.

For the more complete anesthetizing of the drumhead, as well as for operations within the middle ear, such as divisions of adhesions, curetting, removal of the major ossicles, and of the outer epitympanic wall, the procedure of Neumann has been found satisfactorily to answer the desired purpose.

Through a split or fenestrated speculum, an ether spray is thrown upon the superior canal wall at the point chosen for injection of the anesthetic solution, by means of a Pravaz syringe with a curved needle, the point of puncture being the junction of the cartilaginous and osseous portions of the canal, and the needle being carried slowly inward as close to the bone as possible, the injection of the solution covering the whole course of the introduction of the needle.

For still more extensive operative interference on the mastoid portion or for tympanomastoid exenteration, a system of infiltration anesthesia, as carried out by Neumann, has been found to be so far effective as to make it possible to dispense with a general anesthetic. The injections in these cases, made about fifteen minutes before the time for operation, and repeated during the operation if necessary are, for the mastoid incision, three in number, controlling the superior, the inferior, and the middle portions of the mastoid surface. They are made periosteally and in the direction of the incision in the soft tissues. These injections are followed by two entering at the posterior conchal fold and running inward parallel to the posterior canal wall, there being also an injection similar to that made for the purpose of removal of the outer epitympanic wall and other operations in the epitympanum; this combination of the subperiosteal injection of the mastoid with the injection in the canal is sufficient, according to Neumann, to afford a local anesthesia sufficing for the performance of the radical operation and, in fact, in forty radical operations done in Politzer's clinic, in which this method was employed, the resultant anesthesia was effective.

Notwithstanding the favorable reports upon which the author bases his article, he is of the opinion that more intimate observation upon a larger amount of operative material will be necessary to determine decisively the best means by which local may be substituted for general anesthesia in aural operations.

Influence of Pregnancy on Acute and Chronic Suppuration of the Middle Ear.—FERRERI (*Archiv. Italio di Otol.*, 1908, xix, p. 293; *Zentralbl. f. Ohrenheilk.*, 1908, vi, p. 322), in addition to various references to the observations of other writers upon the injurious influence of pregnancy upon otosclerosis, contributes his own observations in this respect, and also in reference to cases in which suppuration is a symptom, as, for example, the common affliction of pregnant women with furunculosis of the external auditory canal, and the fact that pregnancy has an unfavorable effect in the apparent prolongation of suppuration from the middle ear. Under these circumstances it is Ferreri's opinion that, in the event of the occurrence of an acute mastoiditis, operation should be as early as possible, the existence of a nephritis of pregnancy being no counterindication. In one instance under his observation the effect upon a chronic discharge of the ear on a developing pregnancy was so clearly determinable that the patient was first made aware of the existing pregnancy by the increase in the aural manifestations. Cases in which the unfavorable changes in the ear are evidenced during pregnancy present a more favorable prognosis than those in which the same influence is the result of lactation.

PATHOLOGY AND BACTERIOLOGY.

UNDER THE CHARGE OF

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The Experimental Production of Gastric Ulcer in Guinea-pigs.—STERNBERG (*Zeit. f. Heilk.*, 1908, xxviii, 280) has been able to produce ulcerations of the gastric mucous membrane of guinea-pigs, by feeding through a stomach tube, small quantities of alcohol. The lesion starts first as an area of necrosis covered with a slough, developing later into a deep circumscribed ulcer which extends to the muscular coat and heals gradually. The possibility that an abrasion of the mucosa, produced by the passage of the stomach tube, might be the cause of the ulceration was excluded by control experiments. The ulcers were usually situated about the cardia and not, as is the case in man, near the pyloric end. For the production of an ulcer, it is necessary that the alcohol should come in direct contact with the gastric mucosa. This could only be accomplished when the animal's stomach was empty; when the stomach contained food the mucosa was protected and ulcers did not develop.

The Hemolytic Action of Bile and its Inhibition by Blood Serum.—It is known that bile has a toxic action upon at least two tissues of the body. It is hemolytic and directly injurious to the cells of the pancreas. In investigating the protective powers of the organisms against bile, SELLARDS (*Johns Hopkins Hospital Bulletin*, 1908, xix, 268) finds that normal blood serum protects effectively against the hemolytic action of bile salts in dilutions as high as 1 to 3000. Precipitation of the proteid by heat does not affect this inhibitory action. The fact seems to have a distinct bearing upon the tissue destruction in acute hemorrhagic pancreatitis following the injection of bile into the pancreatic duct. The bile itself causes a necrosis of the pancreas, but the hemorrhage would presumably tend to neutralize the action of the bile and thus prevent further necrosis. In simple catarrhal jaundice, except for the protective action of the blood serum, serious consequences, such as the development of a severe anemia, might result.

The Pro-infective (Aggressive) Action of Normal Blood Serum.—COLE (*Johns Hopkins Hosp. Bull.*, 1908, xix, 249), while studying the natural immunity of pigeons to *Bacillus pneumoniae*, made some experiments to determine whether or not this natural immunity was dependent upon substances contained in the blood serum of the pigeon. By means of the technique employed in demonstrating the so-called Pfeiffer phenomenon, an effort was made to study the effect of combined inoculation

of pigeon's serum and emulsions of *Bacillus pneumoniae* into the peritoneal cavity of mice. Into one series of mice 1 c.c. of normal pigeon's serum + 1 c.c. of emulsion of *Bacillus pneumoniae* was injected intraperitoneally; into another control series of mice 1 c.c. of an emulsion of *Bacillus pneumoniae* alone was injected. Fluid removed from the peritoneal cavity in the two series of mice after one hour showed no differences either as regards the type of exudate or the amount of phagocytosis. Attempts were then made to see if blood serum of pigeons and rabbits, when injected simultaneously with emulsions of *Bacillus pneumoniae*, would protect mice against small doses of the organism, doses which under ordinary circumstances were just sufficient to kill. It was a great surprise to find that under these conditions the injection of pigeon's serum or rabbit's serum hastened rather than retarded the death of the animal. The result is quite contrary to what one would expect. The explanation for this phenomenon does not at first seem clear. It is possible that the foreign serum may form precipitins with the serum of the injected mice; that it may bind the complements of the injected animal, thus reducing the bactericidal property of the serum; or that the foreign serum may render the mice hypersensitive, thus setting up a state of conditions analogous to anaphylaxis; it is also possible that the "natural aggressins" described by Bail and others may be due in part to the injection of serum together with bacterial cultures.

The Effect of X-rays upon the Formation of Specific Anti-bodies.—LÄWEN (*Mitth. aus d. Grenzgeb. d. Med. u. Chir.*, 1908, xix, 141) has undertaken an extensive study of the effect of Röntgen irradiation in experimental infections, directing his attention particularly to its effect on the production of specific antibodies. Rats, mice, and rabbits were used in his experiments. Låwen details his experiments at considerable length and arrives at the following results: Long-continued exposure of animals to the x -rays with resultant destruction of the greater part of their leukocytes changes in no way the bactericidal power of the serum. The dissolution of the leukocytes adds no free bactericidal "endo-enzymes" which are capable of increasing the action of the serum alexines. The resistance of the animals exposed to the x -rays, on the contrary, was constantly found diminished for various bacterial inoculations. If the exposures had not been too prolonged, a leukocytosis followed the experimental injections just as in normal animals, the polymorphonuclears being particularly increased. After very long exposure to the x -rays the leukocytes gradually decreased in number, and finally disappeared completely from the peripheral circulation. While the Röntgen rays showed no action on the normal agglutinins, the formation of the specific agglutinins and to a much less degree of the specific bacteriolysins was greatly inhibited. In some animals the agglutinins were not formed at all. From this fact Låwen concludes that the hematopoietic organs are to be looked upon as the place of origin of the specific agglutinins.

Studies on the Relationship between Respiration and Blood Pressure.—THOMAS LEWIS (*Jour. of Phys.*, 1908, xxxvii, 213) finds that the heart is peculiarly susceptible to changes in pressure external to it. In cats a rise of intraperitoneal pressure of 1 mm. Hg. lowers systemic pressure

on an average of 8 to 9 mm. Hg. Conversely, a fall of pericardial pressure of 1 mm. Hg. raises systemic blood pressure by 8 to 9 mm. Hg. In small cats there is a rise of blood pressure accompanying suspended or prolonged inspiration, which is entirely due to the change of intra-pericardial pressure. It is in no measure the result of decreased resistance to the flow through the lung vessels, and, indeed, it has never been conclusively demonstrated that changes in the diameter of the lung vessels resulting from alteration of intrapleural pressure, in natural or vagal breathing, has any appreciable influence as a factor in the production of the inspiratory rise of blood pressure. In large cats the same results could not be invariably demonstrated; nevertheless it seems certain that increased diastolic filling of the heart plays a large part in causing the inspiratory rise of blood pressure in these animals. Further experiments along this same line of investigation showed that in man a deep intercostal inspiration, which is not prolonged, yields a pure fall of blood pressure. A deep, diaphragmatic inspiration, which is not prolonged, gives a pure rise of blood pressure. The rise in blood pressure in abdominal breathing is due to a raised intra-abdominal pressure. In expiration the reverse is true. It is, therefore, not possible, either in man or animals, to state what the blood pressure response to a particular respiratory act will be, unless the conditions and nature of the act are known. Artificial respiration, as ordinarily employed, gives a rise of blood pressure during inspiration and a fall during expiration in all animals. Lewis believes that the *pulsus paradoxus* is a misnomer. Kussmaul's pulse is a normal event, for the blood pressure always falls when the patient, instructed to do so, takes a deep breath.

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ORIGINAL ARTICLES.

THE DIETETIC TREATMENT OF DIABETES.

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THE treatment of diabetes is far from ideal. We are powerless to influence the carbohydrate metabolism directly. No extracts of pancreas, or of other organs, have yet been found productive of definite good. While drugs have their place in the treatment of symptoms and of complicating conditions, none of them have proved of value in combating the disease itself. With the exception of the alkalies, they are at best accessory to thorough dietetic treatment. Unfortunately they are frequently depended upon to replace the latter, with disastrous results. To prescribe arsenic, as is commonly done, and neglect the details of diet, is like leaving a tuberculous patient in a dark ill-ventilated room, and giving creosote to cure his disease. Both are done, but, in the light of the knowledge easily available today, both are dangerously near criminal negligence. Muscular exercise, in some patients, seems to increase sugar combustion to a limited extent, but seldom in the severe types of diabetes, in which it may have the opposite effect. Indirect measures, aiming at increasing the general well-being, are of value, as in all chronic diseases.

Dietetic treatment is our mainstay. Does it actually influence the progress of the disease? I prefer to turn to the reverse side of that question first. Does neglect of proper dietetic treatment hasten the course of diabetes? Emphatically it does in a large proportion of cases. The evidence of this seems clear, although

absolute proof from controlled experiments is out of the question. If this be true, then our first question is answered affirmatively, since the diabetic must eat, and, therefore, must have either proper or improper dietetic treatment. If his physician does not prescribe the former, he will the latter. Furthermore, it is a commonplace of therapeutics that a weakened function should not be overtaxed. It is, therefore, rational to shield the organs concerned in carbohydrate metabolism from constant demands beyond their damaged powers.

We recognize that diabetes is primarily a disturbance of nutrition, in which the power of utilizing carbohydrates is more or less completely impaired; and that, in the more severe cases, there is added to this, secondarily, a disturbance of the fat combustion (possibly also that of the proteins), which results in the production of certain abnormal organic acids. So far as we now have definite proof, all the effects of diabetes upon the general nutrition are due to these two factors; although so able an observer as von Noorden believes that in some cases a toxic destruction of body tissue will also eventually be demonstrated. This, however, is a matter of minor importance.

Because the diabetic can use only a portion, if any, of the carbohydrate of his food, he loses this amount of potential energy through the urine. From this comes the loss of flesh and strength. A gradual increase in the sugar content of the blood is a constant accompaniment of human diabetes. It is the probable source of many of the complications of the disease, especially of the lowered resistance to bacterial infections. The liability to rapidly advancing tuberculosis, when once the bacillus has found lodgment in the lungs; to spreading gangrene, if an artery is occluded; to dangerous carbuncles from slight skin infection, is well known. The development of arteriosclerosis, or of chronic nephritis, is also probably due in part to the hyperglycemia. Acidosis, on the other hand, is a more direct danger, as the forerunner of coma. It, too, when considerable, entails a not insignificant energy loss for the body, for oxidation, which should go on to water and carbonic acid, stops at the good-sized molecules of β -oxybutyric or diacetic acids.

The problem of the management of the diabetic, therefore, is the problem of nourishing the organism with little or no carbohydrate, and, at the same time, avoiding the danger of acid intoxication which arises when no carbohydrate is being consumed.

The main reason why proper dietetic treatment of this important disease has not been more general in this country has seemed to me largely because, on the one hand, the simple underlying principles have not been clearly set forth in English text-books, and, on the other, because the details of diabetic diets have been planned by German investigators for the German stomach and are quite unsuited to our habits and tastes. My object in writing the present

paper is to endeavor to supply these two deficiencies for the general practitioner. I shall not attempt to discuss the many difficult problems which arise in connection with individual cases of diabetes complicated by other diseases, nor to consider the treatment of coma. Neither shall I discuss special and not universally adopted dietetic regimens, such as von Noorden's oat cure, or Mosse's potato cure, which the interested student may easily look into for himself, if he has a firm grasp on underlying principles and the essential details of practical dietetics in diabetes.

DIAGNOSIS. The first principle in treatment is that it be based on a correct diagnosis. In diabetes this means vastly more than the discovery of sugar in the urine. It means the determination of two points: (1) The degree of impairment of carbohydrate metabolism, or its index, the severity of the glycosuria; and (2) the presence or the degree of secondary disturbance of the metabolism, that is, the severity of the acidosis. It can be made only by a quantitative study of the metabolism in these two particulars by the help of accurate chemical methods. These methods, however, are not beyond the ability of any medical student. To Naunyn and to von Noorden and their pupils do we owe this clear conception of the basis for all our dietetic treatment of the disease.

I. Estimation of the Carbohydrate Tolerance. I will first consider the severity of the glycosuria; I prefer to say the determination of the carbohydrate tolerance of the patient. The method is simple. The patient is placed upon an accurate test diet of ample fuel value; that is, containing at least 35 large calories per kilogram of body weight, but made up practically wholly of protein and fat. Such a standard diet, suited to American habits, is shown in Table I.

One will note at once the very considerable amount of fat which it contains. This is of prime importance in the management of the diabetic's domestic economy, the reason being obvious, as we shall see later.

To this test diet is added a weighed amount of white bread. Naunyn uses milk, but in my experience bread is far more acceptable to the patients. If the patient when first seen has been upon a liberal diet and has considerable glycosuria, it is unwise to pass at once to a strict fat-protein diet, because in some cases extreme acidosis and coma have been precipitated by such sudden transition. In these cases one allows three ounces (90 grams) of white bread at the start. In the milder cases, particularly if they have been moderately dieted before one has seen them, I usually order the strict test diet at once in order to save time. Whichever method is employed in the individual case, the bread allowance is reduced until the urine becomes sugar-free, or until the patient has been for at least a week on the strict test diet without losing his glycosuria. Such cases fall into the class of the more severe diabetes; those who lose their glycosuria upon the exclusion or reduction of the carbohydrates are of

the milder type. In further study, these two groups must be sharply separated. For the milder cases, bread in weighed amounts is then added to the test diet, a portion being given with each meal, until sugar reappears. In this way the tolerance for starch in the form of white bread, which contains on the average about 55 per cent. of starch, is determined, and the patient's tolerance is expressed as equivalent to two or three or more ounces of white bread, as the case may be. (See Case I.)

For severe cases, which do not become sugar-free after complete exclusion of the carbohydrates, a reduction of the protein intake must next be made. It has been clearly shown, first by Naunyn, and by all subsequent students, that glycosuria is markedly increased by a large consumption of protein. (See Case II.) Such a test diet, with restricted protein, is given in Table II.

The aim should be to have not more than 14 grams of nitrogen a day appear in the urine. If, on such a diet, the glycosuria disappears, the case may be called, following von Noorden, one of moderately severe diabetes. If it persist in spite of protein restriction and complete exclusion of carbohydrates, it is of severe type. In dealing with the two latter classes it is essential that tests for the acetone bodies should be made frequently, and, if present in any amount, that considerable sodium bicarbonate, one-fourth to one ounce a day, should be given during the whole period.

For ordinary clinical purposes one of the simple fermentation tests for dextrose is a sufficient quantitative method. For those who can afford it, the polariscope is the most convenient accurate means of determining the sugar, readings being made before and after fermentation, and the difference being taken as the sugar percentage. The titration methods are time consuming and unnecessary in ordinary practice.

For the mild cases which tolerate more than three ounces of white bread, a further study of the qualitative tolerance—that is, of the utilization of different forms of starch—may be made, oatmeal, rye bread, potato, rice, barley, or other carbohydrate foods being used in starch-equivalent amount to suit the individual taste. Table IV shows these equivalent amounts. Some diabetics show a distinct divergence in their reaction to different forms of starch. For figures on all food materials, Atwater and Bryant's¹ tables may be consulted.

II. *Determination of the Degree of Acidosis.* As is well known, if a normal individual is suddenly deprived of carbohydrate food, acetone and diacetic acid appear in his urine in considerable amounts, and even β -oxybutyric acid may be found. After a few days he be-

¹ Bulletin No. 28, revised edition, The Chemical Composition of American Food Materials, Corrected to April 14, 1906. Can be secured through the Superintendent of Documents, Government Printing Office, Washington, price 5 cents in currency, not stamps. Also see Joslin and Goodall, Boston Med. and Surg. Jour., 1908, clviii, 248.

Case I.—Mild Diabetes. Age, fifty-four years.

Date.	Amount 24 hrs. c.c.	Specific gravity.	Sugar 24 hrs. grms.	Acetone, Legal's.	Diacetic acid, Gerhard's.	Weight.	Diet.
1907.	II, 22	3350	1031	—	0	177 $\frac{1}{2}$	Much gluten bread and mush, milk, oysters, apple. Strict + 1 apple (but tasted sweets day before). Strict. + 3 oz. bread. + 2 oz. bread.
	III, 11	2650	1016	tr.	0	175 $\frac{3}{4}$	
	IV, 25	2000	1020	++	tr.	176	
	IV, 25	1500	1026	++	0	176 $\frac{1}{2}$	
	IV, 1000	1010	0	0	0	176 $\frac{1}{2}$	

Case II.—Moderately Severe, Progressing to Severe Diabetes. Age, thirty-one years.

Date.	Amount 24 hrs. c.c.	Specific gravity.	Sugar 24 hrs. grms.	Acetone.	Diacetic acid.	NH ₃ .	N.	Weight.	Diet.	Medication.
1906.	VII, 25	3900	1010	—	—	—	—	—	+ 1 oz. toast, 1 potato, $\frac{1}{2}$ oz. oatmeal, 1 orange, 1 tablespoon peas	None.
1907.	X, 30	1021	Trace	Tr.	—	—	—	163	+ 2 oz. toast, $\frac{1}{2}$ oz. crackers, 1 orange.	"
	X, 17	1530	16.8	0	—	—	—	165 $\frac{3}{4}$	+ $\frac{1}{2}$ oz. toast, 2 crackers, 1 orange.	"
	II, 21	1560	39.	++	0	—	—	165 $\frac{3}{4}$	+ 1 oz. oatmeal, 1 oz. crackers.	"
	II, 82	2000	1026	++	tr.	0.81	—	162 $\frac{1}{4}$	Standard.	"
	II, 81	1700	1025	++	++	—	—	165 $\frac{1}{2}$	Standard + Casoid biscuit.	"
	IV, 25	1680	1027	tr.	0	—	—	171 $\frac{1}{2}$	+ 3 oz. oatmeal, 1 oz. corn bread, 5 oz. baked potato.	"
	VII, 19	1230	5.9	+	+	0.03	—	171 $\frac{1}{2}$	Standard.	No work. Hard exercise.
	X, 22	2280	1032	0	0	0.92	—	160 $\frac{1}{2}$	Restricted protein.	Soda $\frac{1}{2}$ oz.
	X, 22	2245	1035	++	++	1.02	—	164 $\frac{1}{2}$	+ 1 oz. oatmeal. High protein, after summer vacation.	None.
	X, 31	1380	1030	++	++	0.42	17.6	164 $\frac{1}{2}$	Strict, but much meal.	Soda $\frac{1}{4}$ oz.
	XI, 6	1290	1027	++	++	1.48	—	167 $\frac{1}{4}$	Strict, with restricted protein.	"
	IV, 1	1900	1027	0.72 gm	+	2.42	15.79	164	Strict, with restricted protein.	"
	I, 10	1800	9.8	0.58	2.12 gm	1.28	16.29	167 $\frac{1}{4}$	Strict, with restricted protein.	"
	31	1540	0	+	1.75	0.56	10.01	166 $\frac{1}{4}$	Hunger day.	"

comes accommodated, as it were, to the altered conditions of his body chemistry and the β -oxybutyric and diacetic acids disappear, while the acetone sinks to the mere trace present in normal urine. Through the work especially of Geelmuyden, Magnus-Levy, and L. Schwarz, it has been made clear that diacetic acid and acetone are derived in this order from β -oxybutyric acid, which is the mother substance of these bodies, and that their appearance and that of the unchanged mother substance represents an abnormal type of metabolism of the fatty acids, which occurs when too little carbohydrate is being burned within the organism. Now in severe diabetes we have a permanent condition in which little or no carbohydrate is being oxidized, no matter how much of it may be consumed; in diabetes, therefore, the acetone bodies attain a peculiar significance. It is not possible to relate them quantitatively with the carbohydrate tolerance, save that the patients who can utilize three ounces or more of bread do not show acidosis. Below this point they may or may not be present. In some severe cases they always are. They should be tested for, in diabetic urine, as regularly as it is examined for sugar. For acetone I would recommend the use of Legal's test; for diacetic acid, the simple ferric chloride test of Gerhardt, controlled by Arnold's, which is less subject to confusion by other substances. These tests may be found in the ordinary text-books of clinical laboratory methods. Tests for β -oxybutyric acid are all complicated, but its presence may be inferred if a urine which contains acetone and diacetic acid is found to be levorotary after complete fermentation.

The quantitative estimation of the acetone bodies is not possible as a routine procedure outside of well-equipped laboratories.² One most important means of estimation of the severity of acidosis remains, however, an indirect method. It is the determination of the ammonia content of the urine. By Folin's recent method, which involves very simple procedures and is applicable by anyone who can afford a suction pump on a water faucet, ammonia can be quantitatively determined, and gives us much information of the amount of abnormal acids which are thus calling forth the manufacture of this basic radicle by the organism, to save it from complete loss of its fixed alkali. When alkali is given therapeutically it combines with a portion of the acids, and the ammonia excretion may fall sharply, while the acid excretion is unchanged or even increased. Under these circumstances its determination alone is no guide to the intensity of the acidosis.

III. *General Examination of the Patient.* Having thus dwelt upon the special features of diagnosis in diabetes, it must not be inferred that aught of the ordinary routine of clinical examination may be neglected. The general condition of the patient and his

² A simple method for approximating the excretion of acetone bodies is given by T. Stuart Hart, *Arch. Int. Med.*, 1908, i, 218.

CASE III.—Very Severe Diabetes. Age, thirty-four years.

Date.	Amount 24 hrs. c.c.	Specific gravity.	Sugar 24	Alcalone,	Diacetic, Gerhardt's.	NH ₃ .	Weight.	Diet.	Medication.
III, 22	3500	1033	238.0	++	+	2.95	111½	+ 5 oz. gluten toast, oatmeal, potato, fruit, etc. Standard + 3 oz. bread, 1 orange, 2 apples.	Arsenic. Stoeh. ½ oz.
" 26	2840	1030	102.2	+++	++	2.95	114	Standard + 3 cauld biscuit.	" " 1 oz.
IV, 2	2400	1028	52.8	++++	+	2.70	117	Standard + 1 cauld biscuit.	" " 1 oz.
" 13	2700	1026	43.2	++++	+	0.65	-	Standard + 3 eggs, cream, bacon, oil, cheese.	" " ½ oz.
V, 4	2100	1020	10.5	++++	++++	0.49	115	Standard + 2 oz. bread, ⅓ grape fruit.	" " ½ oz.
" 29	1700	1036	71.4	++++	++++	0.44	117¾	Standard + cauld biscuit.	" " ½ oz.
VI, 25	1600	1031	39.6	++++	++++	0.74	121¾	Standard, no cream.	" " 1 ½ oz.
VII, 1	2500	1013	27.2	++++	+	1.06	120	Standard, no cream.	" " 1 ½ oz.
" 12	1650	1025	37.9	++++	(+)	0.51	-	2 green days, no cream.	" " ¼ oz.
VIII, 10	2970	1029	88.2	++++	+	1.34	120	Standard + 1 oz. bread, cream 2 oz.	" " ¼ oz.
X, 8	3045	1029	191.8	++++	++++	3.18	112½	Excessive meat. At hotel.	" " ½ oz.
" 15	3240	1030	116.1	++++	++++	4.31	-	2 oatmeal days after 2 green days.	" " ½ oz.
I X, 10	3240	1028	133.1	++++	++++	4.12	113½	Standard restricted protein + 2 oz. bread, 1 apple.	" " ½ oz.
" 25.				++++	++++	4.87	109	Eating little.	" " 1 oz.

weight must be carefully noted. The tongue should be inspected, and the odor of the breath perceived. Heart and vessels, lungs, digestive organs, kidneys, skin, nervous reactions, eyes, all should be systematically examined, with the complications of the disease always in mind. Pulmonary tuberculosis, serious nephritis, or other grave co-existing maladies, as well as extreme inanition with threatened coma, demand individual study of a more complex therapeutic problem, and will be excluded from present consideration.

CLASSIFICATION OF THE CASE. Having determined the degree of impairment of carbohydrate metabolism, and the degree of acidosis in a given patient, it is convenient for purposes of treatment to assign him to a category. It must be clearly held in mind, though, that all categories are artificial; also that they are insufficient for prognosis. A young person with mild diabetes is unlikely to live so long as an old man with much more severe glycosuria, for clinical experience has demonstrated that the disease in the first instance will almost surely be progressive. We must be prepared to reclassify our cases as we observe them. Fortunately we may, with a proper diet therapy, have the great satisfaction of seeing the tolerance of some patients improve. (See Case IV.)

For clinical purposes, Naunyn's³ criterion of the mild form of the disease I would strongly urge. It is the ability to take a not irrelevant amount of bread, two ounces (60 grains) or more, without producing glycosuria. Von Noorden classifies from the same standpoint. Practically, diabetics who are restricted to a less amount of bread than this have as great temptation to exceed their tolerance as those in whom starch is wholly interdicted. In addition, the amount which can be allowed is an insignificant fraction of the normal carbohydrate content of a mixed diet, and without real value in the attempt to maintain normal nutrition.

Individuals with a tolerance below this point, but who become sugar-free on a diet without carbohydrate, I consider moderately severe cases, following von Noorden's⁴ usage. Those who, in addition to exclusion of carbohydrates, require restriction of their protein intake to rid the urine of sugar, are severe cases. The most severe types show glycosuria on a restricted protein diet, or a constant marked acidosis in addition to severe glycosuria. Mandel and Lusk⁵ have called attention to the occurrence of total carbohydrate intolerance, with dextrose appearing in the urine on a protein-fat diet in the same proportion as in complete phloridzin glycosuria, D : N : : 3.65 : 1. Von Noorden reports even higher figures. Where absolute control of the diet and exact sugar and nitrogen determinations are possible, this ratio deserves further study. I would warn,

³ *Der Diabetes Mellitus*, second edition, Vienna, 1906, p. 185.

⁴ *Diabetes Mellitus*, New York, E. B. Treat & Co., p. 177.

⁵ *Deut. Arch. f. klin. Med.*, 1904, lxxxi, 472.

CASE IV.—Mild Diabetes; Age, fifty-two years.

Date.	Amount 24 hrs. c.c.	Specific gravity.	Sugar 24 hrs. grms.	Acetone.	Diacetic acid.	Weight.	Diet.
1903.	VII, 26	1017	40.8	—	—	133	Supposed strict, but 8 oz. gluten bread, 1 quart milk, little fat.
	VIII, 13	1020	40.8	—	—	132	Strict 4 days.
	IX, 13	1026	2.7	—	—	135 ¹ / ₂	+ 4 oz. bread.
1904.	IV, 14	1050	1.8	—	—	—	+ 1 oz. bread, 1 oz. oatmeal, 1 apple.
	XI, 18	1030	22.0	+	0	140	+ 2 oz. toast, 6 oz. potato, 3 apples (against orders).
1905.	I, 9	1030	11.47	—	—	139 ³ / ₄	+ 4 oz. bread, 1 orange.
	VI, 24	1017	—	—	0	137	+ 3 oz. bread, 1 orange, following 4 days strict.
	XII, 30	1010	—	—	0	—	+ 5 oz. bread, 6 oz. potato, 1 orange.
	XI, 30	1010	—	—	0	—	+ 7 oz. bread or equivalent.
1906.	II, 27	1025	36.4	—	—	—	+ 3 oz. bread, 3 apples (against orders).
	IX, 27	1029	5.4	—	—	138	Strict.
	III, 24	1022	0	+	0	—	+ 5 oz. bread.
	V, 10	1020	0	+	0	—	+ 6 oz. bread, some fruit.
1907.	X, 1	1022	2.7	+	0	—	Strict + ¹ / ₂ grape fruit.
	I, 5	1020	0	+	0	—	+ 3 oz. bread, 1 orange.
	VI, 25	1017	1.4	+	0	—	+ 3 oz. bread, 1 orange.
	II, 21	1000	1012	tr.	0	137	+ 5 oz. bread.
	V, 8	1016	2.88	tr.	0	—	+ 3 oz. b. cad.
	VI, 6	1009	0	tr.	0	—	+ 7 oz. bread.
1908.	X, 31	1016	6.6	tr.	0	137	+ 3 oz. bread, following 2 days strict.
	I, 21	1012	0	tr.	0	—	—

however, against the acceptance of figures from any diet containing cream, since I have learned that some diabetics show marked intolerance of even the minimal amount of lactose and of the casein in the heaviest centrifugal cream; also that lactose is not the sole carbohydrate present in commercial cream.

TREATMENT. We are now prepared to take up the therapeutic problem as it presents itself in these different stages of the disease. We shall succeed best, I think, if we conceive the problem as the maintenance of adequate nutrition in the diabetic individual, in such manner as to prevent or minimize, first, hyperglycemia, and, second, acidosis.

I. The Maintenance of Nutrition. The normal adult provides from 1500 to 2000 calories of his daily energy requirement in the form of carbohydrates. For the diabetic almost all of this is lost; he must, therefore, be nourished on protein and fat. A glance at Case III, when she first came under treatment, will show that, with a very moderate consumption of carbohydrates, 238 grams of sugar, representing about 950 calories (1 gram = 4.1 calories), was wholly lost to the organism. Even in mild cases the tolerance for starch is seldom great enough for us to count on it for more than a fraction of the needed energy.

Ruebner⁶ has shown that, with increase in protein consumption, there is increase in the total metabolism, therefore, of the energy requirement. He names this the specific dynamic action of protein. On this account it is unwise to feed more than a moderately increased amount of protein, say 150 grams a day. Since the caloric value of protein is 4.1, we can at best provide 600 calories in this way, leaving about 2000 for the average man to be taken in the form of fat.

How can this be contrived? The test diets which I give herewith contain about 2000 calories in fat (1 gram = 9.3 calories), and one will note that butter, thick cream, bacon, oil, and cheese figure largely. The first three are foods of the utmost importance for the diabetic. One may also take pains to select the fatter meats and fish, pork, fat beef, and mutton, and salmon, for instance. In this way there is no great difficulty in introducing the necessary amount of fat into the diet.

A somewhat greater difficulty arises in having it eaten. Fat food is not agreeable to many persons, and in some cases causes digestive disturbances and diarrhoea. As a help in fat digestion alcohol is of distinct value, and it is next to impossible to give the large amounts of fat necessary in diabetes, without wine or spirits being taken at the same meal. Whisky or brandy, Rhine or Moselle wine, claret or Burgundy, may all be used, but sweet wines are of course prohibited. The amount should not exceed an alcohol content of 40 grams in the day. As alcohol has a fuel value of 7

⁶ See Lusk, *Science of Nutrition*, Philadelphia, 1906, p. 135. This book should be consulted by every physician who is unfamiliar with the fundamental principles of nutrition and scientific dietetics.

calories per gram, it is in itself not to be despised as an additional source of energy in these cases.

Case IV has been to me an instructive example of the need for alcohol in the diabetic dietary. Being a Methodist clergyman, he objected seriously to having it known that he took whisky, and would always abandon its use every few months. Each time he did an attack of fatty diarrhœa made him speedily resume it.

In the more serious types of diabetes, the problem of securing adequate nutrition is further complicated by the necessity for considerably restricting the protein intake, even to below the normal figures, because of the effect on the glycosuria. Here we must use great care in the calculation of the energy equivalent of the food given, or malnutrition will speedily result. Even this problem, however, is perfectly solvable, and one may keep patients for considerable periods on diets containing 80 grams of protein or less. Case II shows clearly the benefits of such a method.

In hospital practice the greatest obstacle to a proper diabetic dietary is the expense of the best fat-containing foods, cream being practically prohibited. It is much harder to provide variety, so that the patients tire of their food, and with loss of appetite there is loss of strength as well. Under such unfortunate conditions one may be obliged to depart somewhat from the best methods of treatment in order to preserve his patient alive.

I would insist strongly upon the need for attention to even the smallest detail in the arrangement of diets, and the encouragement of patients as well to work out the greatest variety possible to them within the limitations prescribed. One must always remember that, in calculating the energy value of any diet, the calories lost in the form of sugar excreted should always be subtracted.

II. *The Control of Hyperglycemia.* In every case of diabetes our aim should be to free the urine from sugar; that is, to prevent hyperglycemia. This may not always be possible, and it may at times be necessary to abandon the aim temporarily. But the physician will succeed best who keeps this as his main objective in the treatment of diabetes. With increasing experience he will find it increasingly possible of attainment.

The two chief obstacles are psychical, not physical. They are laziness or ignorance on the part of the physician, and self-indulgence on the part of the patient. In no chronic disease is coöperation between patient and physician more essential than in diabetes. When we demand of a patient a life of the most irksome watchfulness and self-restraint, he is at the least entitled to a reasonable explanation of the why and wherefore. This we must be able to give him simply and convincingly. Without this ability to enlist his help, all effort at treatment is likely to be futile.

Certain general directions may be laid down for all cases. Sugar and sweets in every form must be permanently interdicted. It is also important that patients should be taught to avoid often unus-

pected sources of starch, such as sauces, gravies, and soups thickened with flour. It is well that they should be provided with a list of the foods which are allowed and of those which are forbidden, and should be quizzed on these until sure of their ground (Table III). Excessive water drinking is unwise. I need not say that all matters of daily hygiene should be inquired into and regulated.

More specific dietetic directions will depend upon the classification of the case. In the mild forms, with a tolerance for two ounces or more of bread, it is essential that the carbohydrate tolerance be never exceeded. Many physicians and patients are satisfied if the percentage of sugar in the urine remains small. This is to invite future trouble. When a diabetic who can tolerate three ounces of bread shows glycosuria, it is *prima facie* evidence against either his physician or himself.

A period of strict diet should initiate treatment in all cases. Following this it is well to limit the consumption of starchy foods to not more than three-quarters of the tolerated amount, with occasional periods of strict diet, and yearly or half-yearly determinations of the tolerance anew.

These milder cases may be allowed to choose the form in which they will take their allotted portion of carbohydrate, if provided with some simple table of equivalents, such as Table IV. It is well, however, to make a few tests to guard against the idiosyncrasy to certain forms of starch which some patients show. The very mild cases, in older people, may have one of the vegetables or fruits from Table V each day.

Von Noorden's⁷ plan of arranging the diet in periods is immensely helpful, and I should advise physicians to familiarize themselves with its details, which may be found in his Herter lectures on Diabetes.

In the moderately severe cases, by careful study of the effect of restricted protein, one may prevent glycosuria over considerable periods, or reduce it to a minimum. In this class the interposition of one or two days of very low diet containing but little protein is of great value. Naunyn gives mainly broths, and calls them "hunger days;" von Noorden gives green vegetables, with a few eggs, a little fat, as bacon and butter, black coffee, and alcohol in some form, and calls them "green days." As a rule, patients prefer the latter, since they are less conscious of the starvation. The principle is the same. Cases II and III both show the striking effect of such days upon glycosuria. Table VI gives a simple "green diet."

In the severest cases the prevention of glycosuria is manifestly impossible, since it is still present on a carbohydrate-free diet, even after restriction of the protein. The management of these cases requires experience and individual study, and does not lend itself to any brief presentation. I am convinced that even in them much can be done to prolong life by a well-conceived dietetic treatment.

⁷ Diabetes Mellitus, New York, E. B. Treat & Co., p. 177.

Case III seemed on the verge of coma when I saw her. The physician who had last had her had ordered considerable carbohydrate food for fear of this occurrence, and she grew rapidly worse. You will see from the chart how glycosuria was decreased, acidosis diminished, and weight at the same time increased, with stringent dietetic treatment. I have had a number of similar experiences.

III. *The Prevention of Acidosis.* These more severe cases present a double problem. Acidosis, which occurs during carbohydrate starvation in the normal individual, assumes much more serious proportions in the diabetic. When present it should be watched during treatment as carefully as the glycosuria. The milder grades diminish spontaneously after the first few days of strict diet, and need occasion no alarm. When the ammonia output, however, rises to 2, 3, or more grains a day, and a strong ferric-chloride reaction is constantly present in the urine, one must proceed cautiously with prolonged periods of strict diet, and must especially avoid sudden changes in the carbohydrate content of the food. Considerable amounts of alkali, one-half to one ounce of sodium bicarbonate, must be given daily in these cases. A portion of this may be replaced by sodium citrate if desired.

Shall we in any given case abandon the attempt to minimize the glycosuria because of an existing acidosis? This is the difficult question which arises in all severe cases. I can only express my opinion, which grows stronger with every successive case of this type that I handle, that the attempt to overcome the acidosis by allowing much carbohydrate, almost always fails of its purpose. With severe grades of diabetes this carbohydrate does not enter into the metabolic processes of the organism, and, therefore, is without value in aiding the proper oxidation of the fatty acids, merely adding hyperglycemia, with resultant polyuria and thirst, to the trouble already existing. In such cases permanent restriction of the protein is of the greatest value, and occasional "green" or "hunger" days are essential. It is not yet clear which of the fats cause the highest production of oxybutyric acid, and I do not think that we are in a position to draw any practical guidance from the experiments thus far made, save that it is perhaps wise that butter for such patients should be freed from contained butyric acid by thorough washing. For help in the management of this difficult combination I must refer those interested to Naunyn's and von Noorden's books.

IV. *Diabetic Foods.* Every reader has probably noted a conspicuous omission from the dietetic measures I have recommended, namely, gluten bread. From my experience I say, without hesitation, that gluten bread is the diabetic's worst enemy. Taught by the dealer, or, worse yet, by the physician, not only that it is safe for him to eat, but sometimes even that it is actually a cure for the disease, he eats it in large quantities.

If one would know what gluten breads usually are, he should

examine the most instructive analyses of diabetic foods made by Winton.⁸ They are one of the great frauds of the age. The best gluten breads contain over 30 per cent. of starch; the worst, such as the Jireh products, much more than ordinary white bread. The only preparations of this type available in this country which contain under 10 per cent. of carbohydrate are the gluten foods made by Herman Barker, Summerville, Massachusetts; the Soja bean meal of the Theodore Metcalf Company, of Boston; and the casoid flour and biscuit of Callard, Stewart, and Watt, Limited, of London. The large casein content of the last is objectionable, since casein increases glycosuria more than any other protein.

At the best, even these are a very small help in providing something to eat more butter on, and fulfil no real function. It is better to allow the carbohydrate one does give in the form of familiar and longed-for foods, such as white bread, the starch content of which is well known.

In concluding, I trust that I have persuaded some that the intelligent treatment of mild diabetes is possible to any practitioner of medicine, and is of immense importance. Just as in tuberculosis we have learned that early diagnosis and treatment offer our main hope, so in other chronic diseases, of which diabetes is an excellent example, may we, by the prompt institution of thoroughgoing dietetic treatment immediately upon the discovery of its first indications, hope to prevent the development of the more severe and intractable forms of the disease. Increasingly early diagnoses, and increasing power to control the chronic diseases in their incipency, will distinguish the medicine of the future, and we have the making of that future in our hands.

TABLE I.—Standard Strict Diet.

Breakfast:

- Coffee with 1½ ounces cream.
- 2 eggs cooked with ½ ounce butter.
- 3 ounces ham.

Luncheon:

- Bouillon with 1 raw egg.
- 3 ounces sirloin steak, chicken, or leg of lamb.
- 1 ounce bacon.
- Vegetable from list, 2 tablespoonfuls, with ½ ounce butter.
- Dessert made with 1 egg and 1½ ounces cream.⁹
- 6 ounces wine, or 1 ounce whisky or brandy.

Afternoon tea with ½ ounce cream.

⁸ Report of the Connecticut Agricultural Experiment Station, 1906, p. 153.

⁹ The following recipes for desserts are suggested:

Baked custard: One egg, 1½ ounces of cream, 2½ ounces of water; two or three ½-grain saccharine tablets, 8 drops of vanilla essence. Beat up well, pour into a buttered dish, grate a little nutmeg on top, and bake twenty minutes.

Coffee ice-cream: 1½ ounces of cream, 1½ ounces of water, 1 ounce of strong coffee, two or three ½-grain saccharine tablets. Dissolve. Add one egg, well beaten. Mix in a saucepan and beat slowly with stirring until it thickens. Set aside until cool; then freeze.

Dinner:

Any clear soup.
 3 ounces fish (salmon, shad, or mackerel), with $\frac{1}{2}$ ounce butter.
 $\frac{1}{4}$ pound roast pork, beef, mutton, turkey, or lamb chops.
 Vegetables from list, 2 tablespoonfuls, with $\frac{1}{2}$ ounce butter.
 Salad with $\frac{1}{2}$ ounce oil in dressing.
 1 ounce cheese, English, pineapple, Swiss, or full cream.
 6 ounces wine, or 1 ounce whisky or brandy.
 Demitasse of coffee.

Protein	= 126 grams; 515 calories
Fat	= 222 grams; 2065 calories
Carbohydrate	= 15 grams; 60 calories
Alcohol	= 30 grams; 210 calories

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Vegetables Allowed.

Asparagus, beet greens, Brussels sprouts, cabbage, cauliflower, celery, chicory, cresses, cucumbers, egg plant, endive, lettuce, mushrooms, radishes, rhubarb, salsify, spinach, string-beans, tomatoes, vegetable marrow.

TABLE II.—Standard Diet with Restricted Protein.

Breakfast:

Coffee with $1\frac{1}{2}$ ounces cream.
 2 eggs with $\frac{1}{2}$ ounce butter.
 1 ounce bacon.

Luncheon:

2 eggs.
 1 ounce bacon.
 2 ounces lamb chops (1), ham (2), beefsteak (3), chicken (4), or fish (5) broiled with $\frac{1}{2}$ ounce butter. (Each day select meat with same number for luncheon and dinner.)
 Vegetable from list, 2 tablespoonfuls, with $\frac{1}{2}$ ounce butter.
 Dessert made with 1 egg and $1\frac{1}{2}$ ounces cream.
 6 ounces wine or 1 ounce whisky or brandy.

Afternoon tea with $\frac{1}{2}$ ounce cream.

Dinner:

Any clear soup.
 $\frac{1}{4}$ pound roast pork (5), beef (4), mutton (3), turkey (2), chicken (1), or lamb (1).
 (Each day select meat with same number for luncheon and dinner.)
 Vegetables from list, 2 tablespoonfuls, with $\frac{1}{2}$ ounce butter.
 Salad with $\frac{1}{2}$ ounce oil in dressing.
 1 ounce cream cheese.
 6 ounces wine or 1 ounce whisky or brandy.
 Demitasse of coffee.

Protein	= 82 grams; 334 calories
Fat	= 215 grams; 2008 calories
Carbohydrate	= 15 grams; 60 calories
Alcohol	= 30 grams; 210 calories

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TABLE III.—General Diet List.

Eat no sugar or made dishes containing sugar, no starchy foods, such as bread of any kind, cereals, potato, rice, peas, dried beans or macaroni, soups or sauces thickened with flour, and no milk.

Try to eat every day much butter, bacon, oil on salad, and cheese, especially cream cheese. A small amount of cream (up to 4 ounces a day) may be taken in coffee and tea. Saccharine, $\frac{1}{2}$ grain, may be used for sweetening.

Whisky with water, or a light Rhine wine or claret, may be drunk with dinner and supper.

Foods Allowed.

Clear meat soups.

All meats except liver.

Eggs in any form.

All fish except oysters, clams or scallops.

As desserts, jellies, or custards, or ice-cream, made with cream and eggs, and sweetened with saccharine, and flavored with vanilla, coffee, or brandy.

Cream, cheese, and the following vegetables: Asparagus, beet greens, Brussels sprouts, cabbage, cauliflower, celery, chicory, cresses, cucumbers, egg plant, endive, lettuce, mushrooms, radishes, rhubarb, salsify, spinach, stringbeans, tomatoes, vegetable marrow.

TABLE IV.—Table of Equivalents.

Article.	Per cent. carbohydrates.	Amount in ounces equal to 1 ounce white bread.
Breads:		
White	51-55	1
All other	47-53	1
Rolls and biscuit	52-60	1
Cornbread	46	1½
Crackers, average	69-72	¾
Cereals:		
Oatmeal, boiled	11.3	5
Hominy, boiled	17.8	3
Macaroni, boiled	15.8	3¼
Rice, boiled	24.4	2½
Tubers and Legumes:		
Potatoes, cooked	18-20	3
Parsnips	13	4
Beans, baked	20	2¾
Beans, lima, cooked	20	2¾
Peas, green, cooked	15	3½
Milk	4-5	10
Fruits:		
Apples, apricots, and pears	12-14	4
Cherries	15	3½
Huckleberries	16	3¼
Plums	20	2½
Bananas	22	2½
Nuts:		
Filberts	12	4½
Almonds	15	3½
Peanuts	22	2½

TABLE V.—For Mild Cases.

List of vegetables and fruits with less than 12 per cent. carbohydrates: 3 ounces of any one of these may be taken daily.

Vegetables 5 to 10 per cent.:

Onions, squash, turnips, okra, carrots.

Fruits below 12 per cent.:

Lemons, watermelons, strawberries, gooseberries, muskmelons, cranberries, blackberries, currants, grapefruit, oranges, raspberries, sour apples.

Nuts:

Butternuts, hickorynuts, walnuts.

TABLE VI.—Green Days.

Breakfast:

- 1 egg, boiled or poached.
- Cup of black coffee.

Dinner:

- Spinach with a hard-boiled egg.
- $\frac{1}{2}$ ounce bacon.
- Salad, with $\frac{1}{2}$ ounce oil.
- 6 ounces of wine or 1 ounce of whisky or brandy.

4.30 P.M.:

- Cup of beef tea or chicken broth.

Supper:

- 1 egg, scrambled, with tomato and a little butter.
- $\frac{1}{2}$ ounce bacon.
- Cabbage, sauerkraut, string-beans, or asparagus.
- Cup of tea.

$\frac{1}{2}$ ounce of sodium bicarbonate in the twenty-four hours.

CARDIAC DANGERS IN HIGH ALTITUDES.

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THE dangers to the heart in high altitudes are, I believe, precisely the same as elsewhere, but very sharply exaggerated in certain directions. The most frequent and serious of these troubles are found in connection with myocarditis, arteriosclerosis, and dilatation of the heart.

Leaving the physiology involved aside for the present, we may fairly assume that the heart and lungs have to meet increased demands with each added degree of elevation and its consequent decrease in atmospheric pressure. Common experience will teach one this, even though he knows nothing of physics. To meet the increased circulatory demand the heart must hypertrophy if one is to take his usual exercise.

The robust miners who work at 10,000 or 12,000 feet elevation have a cardiac area extending to the nipple line, in spite of their more voluminous lungs, for increased lung capacity is equally necessary in their work. It is found that the Virginia deer has less heart weight in proportion to body weight than our own blacktail deer; yet the latter, when fat in the fall, can hardly run a half mile, when high in the mountains, without becoming almost exhausted, as I can testify from personal knowledge.

It is not strange, then, that we see frequently cases of acute dilata-

tion after comparatively slight effort in those whose arteries have begun to harden, and who have been accustomed for perhaps fifty years to a sea-level pressure. There are at least three contributory factors to be noted: those coming to the mountains are frequently professional men and others equally "out of training," who still wish to climb a mountain on the day of their arrival; the bracing air gives them a sensation of increased physical and mental vigor, so that they feel like undertaking a big feat, and are led into undertaking too much of a feat; and I have known repeatedly of trouble indirectly from climatic conditions, which, being new and strange, were the cause of overexposure or overexertion.

Thus I have seen recently a man, aged sixty-seven years, who walked three miles on a fine day and failed to meet his friend, with whom he expected to ride back; a heavy head wind meanwhile arose and in trying to walk against it, his heart gave out, he fell to the ground, became chilled, contracted pneumonia, and now lies at the point of death. Many a patient walks in the foothills or mountains until beginning fatigue warns him to return. Before reaching home he is utterly exhausted; and the physician finds him with a widely dilated heart and a mitral leakage.

One patient had been a hunter and trapper in the Rocky Mountains until fifty years of age, when he purchased a ranch in the Arkansas Valley at an elevation of only 3000 to 4000 feet. Seven years later some friends visited him from the East and he took them up Long's Peak, over 14,000 feet in altitude. He suffered greatly from palpitation and dyspnoea, but his grit being better than his judgment he continued until he dropped from exhaustion. When he started he was a hale looking ranchman of fifty-seven years, with no suggestion of heart disease; when I saw him a few days later with Dr. Spivak his heart was greatly dilated, the mitral valve leaked, and there was general dropsy. Death resulted in a few days. The death of Dr. Nicholas Senn is stated in the medical press to have resulted from just such overstrain in the high altitudes of the mountains of La Paz, in South America.

The unseasonable and unexpected fall of snow has, in a similar manner, in some of my patients, occasionally demanded more effort than was anticipated, in getting back to camp or hotel, with resulting overstrain of the heart. Any of these troubles might have developed elsewhere, but the means for rapidly exhausting the strength of an ill-nourished heart muscle seem to be less easily attainable at sea level than here.

In those with but a narrow margin of heart strength the increased work of heart and lungs, as they ascend in a railway train, may bring trouble. A Pullman conductor who had run for many years over the highest point of the Union Pacific Railway, told me that he had had eight deaths occur in travellers upon his ears as they neared the high point of the route. Presumably most of these were from

causes allied to those I am discussing. Several such have fallen under my notice.

I have the impression that attacks of angina pectoris in those disposed to the disease, are more easily provoked here than in the East. This may be because I have known of two or three patients who had the attacks upon very slight exertion or excitement; but my experience with this disease elsewhere is so limited that I hesitate to more than mention this belief.

Without statistics to prove it I am equally impressed with the belief that atheromatous patients with increased blood pressure are more liable to disaster than those without such increase. The failure by even a small margin to maintain the required pressure disturbs the circulatory conditions profoundly.

I have just sent East a woman, aged forty-three years, who presented premature senility and marked arteriosclerosis, with an increase of 50 per cent. in her blood pressure. She complained within a few days of arrival that a walk of a mile had exhausted her so that she barely reached her hotel, and especially that her legs were so tired as to be painful, though they recovered after a short rest. She had never had such symptoms before. Her heart was dilated, the mitral valve leaked, and the feet were cold. No arterial pulsation could be found in either foot. The intermittent lameness here had as its base the usual arteriosclerosis, but the exhaustion of a feeble heart muscle, insufficiently supplied with blood, and called upon for increased work because of the unaccustomed altitude brought the trouble to an immediate crisis. I do not doubt that her blood pressure was still higher before her overexertion here, and its fall with the acute dilatation of the heart would account for the sudden development of the symptoms.

Patients with extreme mitral stenosis, whose hearts are suddenly called upon for greatly increased work, are in grave danger anywhere, but especially so here. I have seen three deaths in young patients within the first seventy-two hours in acute pneumonia under these conditions: in one within thirty hours from the initial chill; a fourth escaped by the narrowest margin, the pneumonia aborting at the end of forty-eight hours after Dr. Rover and I believed that death was imminent.

Very moderate exertion in young man whose mitral orifice was extremely narrowed, as we learned at the postmortem examination, brought on pulmonary œdema, with expectoration of enormous quantities of pink serum, and death in three hours. A similar case with presystolic murmur and thrill, seen with Dr. H. B. Whitney, was saved by prompt and copious venesection.

Patients with hearts greatly exhausted by chronic disease, as in phthisis, pernicious anemia and similar troubles, are occasionally seriously embarrassed by the increased demands of the altitude, even though no physical exertion be made. I have seen cases

of advanced tuberculosis in which, upon arrival here, this heart weakness, together with the greatly diminished lung area, caused acute suffering, demanding immediate return to a more favorable elevation. This may be advised the more readily because no possible climatic advantages can be of any service to such patients. The atrophic heart of wasting disease, the decreased lung area, the anemia, the general weakness, the exertion of coughing, and the mental anxiety, are all doubtless contributory factors.

In fairly compensated valvular lesions I have seen death follow a sudden break in the compensation from a single severe overexertion. The same factors which operate upon the arteriosclerotic heart are active also in these cases, as well as the greater demands which given work makes upon this organ, the liability to overexertion because of the stimulating climate, etc. A typical example is that of a boy, aged eighteen years, with well-compensated aortic regurgitation following rheumatism. He was quite an athlete in the early days of wheel riding, and rode one day with this club to a point twenty miles away in the foothills. This he did quite easily, but it evidently was all that he should have done that day. On returning in the afternoon he found that a stiff head wind had arisen, and with all the exertion he could make he was not able to keep up with his companions. He went to bed on reaching Denver, and presented, when I examined him, a greatly dilated heart, mitral regurgitation, general anasarca, albuminuria, and all the signs of imminent death from acute cardiac failure. His death was reported to me by his physician a few days later.

A long experience here convinces me, however, that the average case of well-compensated valvular disease does as well here as anywhere else. The relative infrequency of acute rheumatism as compared with some harsher climates, is advantageous. Those acclimated and well accustomed to the seasonal and topographical peculiarities of a mountainous region, are not so likely to fall into the errors I have noted as newcomers would be.

Patients with valvular disease, but with well-nourished heart muscle and fair arteries, may, almost regardless of age, I believe, go to reasonably high altitudes with safety, if only they follow the rule I have long laid down for my cardiac patients, namely, to make no exertion which causes any considerable dyspnoea. After any failure of compensation occurs it is better to avoid the increased demands involved.

THROMBOSIS OF THE INFERIOR VENA CAVA.

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THE value of reports of unusual cases lies, first, in the clinical interest and attention aroused by anything out of the ordinary, and, second, in the educational value of this attention if it is pursued to a logical conclusion. A report of two cases of thrombosis of the inferior vena cava, therefore, should prove of some interest, particularly if it includes a study of the manifold clinical manifestations of the condition. This communication concerns two such cases, Case I being acute and possibly a sequel of influenza, and Case II being chronic, the diagnosis being made possible by the collateral circulation.

CASE I.—A man, aged twenty-six years, single, a clothing salesman by occupation. His personal history is uneventful, with the exception of typhoid fever four years previously, from which he made a good recovery. He has noticed a gradual gain in weight the past few months. Two weeks before the onset of the present illness the patient was confined to his bed a few days with influenza, but after three or four days he was able to be about and returned to work. He felt well for a week, but at the end of this time, while lifting a heavy case of dry goods, he was seized with a severe pain in the right side. On examination his physician found his abdomen tender, with some ascites, and diagnosticated probable cirrhosis of the liver.

When seen by E. R. S., five days later, the man seemed desperately ill; his face was drawn, anxious, and very pale, but he was able to talk intelligently with a very weak voice. On examination he appeared to be rather well-built and muscular. His heart and lungs were negative. There was no fever. The abdomen was enormously distended, tense, symmetrical, and tympanitic on percussion, with slight tenderness. The liver and splenic dulness were not demonstrable. No fluid in the abdominal cavity could be discovered on account of the tympanites. The legs and external genitalia were much swollen, œdematous, and cyanosed, but not tender or painful, except for the tenseness and tightness due to the œdema. The history of the swelling was that it had come on gradually since the onset of his illness. Rectal examination was negative. The bowels moved regularly. The urine on examination was free from albumin, and in other respects negative.

The appearance of the abdomen suggested an intestinal obstruc-

tion or paresis with tympanites, due to some subacute inflammatory exudate in the pelvis obstructing the iliac veins, or a possible neoplasm or a tuberculous peritonitis.

An exploratory operation was advised, but was refused. At this time the superficial veins were not noticeably prominent. The patient lived about three weeks and died of exhaustion.

The autopsy, made twelve hours after death, revealed the following important findings:

The lungs were negative, with the exception of a few adhesions at the left apex and a few small infarcts. The heart was normal. The legs and genitals were swollen and oedematous, but no distended veins were noticeable on the legs or abdomen. The left arm was also oedematous and swollen up to the mid portion of the humerus. On opening the abdomen the abdominal fat was found atrophied and the abdominal wall was 1 cm. in thickness. A large amount of embalming fluid, somewhat blood-stained, escaped. There were no adhesions between the coils of intestines and the parietal peritoneum. The spleen was much enlarged and very hard. The liver measured 25 x 20 x 10 cm.; the surface was smooth. The left lobe was much larger than the right, measuring 12 x 15, while the right measured 17 x 12 cm. The left lobe occupied almost the position normally occupied by the right, that is, the midline. The right lobe was pushed to the right and turned backward, bringing the gall-bladder well under the costal margin in the axillary line. The consistency of the liver was normal, and on section there was considerable passive congestion. The gall-bladder, œsophagus, stomach, pancreas, and adrenals were normal. The inferior vena cava, found to the right of the aorta, was widely dilated, thrombosed, and solid; on section it was found to contain a partially organized blood clot, which extended downward into both common iliac veins and upward to the groove in the posterior surface of the liver, where, near the upper surface of the liver, it ended. The walls were much thickened, fused together, and firmly adherent; the lumen was obliterated. The vessel above that was collapsed and empty. The hepatic and renal veins were also blocked by thrombi continuous with that in the vena cava. The portal system was not obstructed. The anatomical diagnosis was: Oedema of both legs and left arm; dilatation of the superficial veins above the costal margin; oedema of the genitals; thrombosis of the inferior vena cava, renal, and hepatic veins; ascites; multiple infarction of the left lung; adhesive pleuritis of the left apex; chronic passive congestion of the spleen and liver; rotation of the liver to the right and enlargement of the left lobe; peptic ulcer of the duodenum.

On reconsideration of the case two possible causes of the thrombosis are prominent: (1) Influenza may have been the primary cause, and the thrombosis may have been due to a secondary

influenzal thrombophlebitis with extension into the inferior vena cava. This disease is not infrequently associated with thrombosis. Leyden and Guttman have collected twenty-eight cases of thrombosis of the large veins occurring in the epidemic of 1889 and 1890, and thrombosis of the smaller veins is quite common in the disease. On the other hand, the strain of lifting may have caused the tilting over to the right of the liver, causing a twist of the vena cava which mechanically caused a thrombosis. If so this case is unique, the only case approaching it being one reported by Jobert,¹ in which a soldier, after a severe and exhausting march, was suddenly seized with swelling of both legs and the abdomen. He improved after four weeks, but five years later showed the development of a collateral circulation typical for thrombosis of the inferior vena cava.

CASE II.—E. W., aged forty-two years, unmarried, an orderly. The chief complaint was swelling and ulceration of the legs. The patient has never been seriously ill. He denies venereal infection. There has been no history of digestive disorders or disturbances of the central nervous system. He has never been short of breath and there has been no swelling of the feet or ankles. The urinary functions have been normal. He states that from twenty-one years of age he was employed as a bartender and used alcohol to excess, and at that time was using tobacco freely, smoking ten to fifteen cigars daily. Coincident with this overindulgence in alcohol he began to have attacks of chills and fever, lasting two or three days. At first these attacks occurred once a year, but later with greater frequency, until finally they came once in three weeks.

The present illness began in 1893. The onset was sudden, with a severe pain in the calf of the left leg, sharp and sticking in character. The patient was in apparent good health at the time and was sitting in a chair at rest. The pain was so great he was unable to bear his weight on the foot and went to bed. On the following morning the leg was still very painful and greatly swollen as far as the knee. The second morning on arising, the right leg was affected in a similar way; the pain, however, was not localized, but affected the whole leg, which began to swell immediately. The swelling began in the toes and extended upward, until at the end of ten days the whole leg was swollen. The leg became black at first, but gradually the natural color returned. About three weeks afterward an attack of pleurisy suddenly developed on the left side, which, with the swelling in the legs, kept him in bed three months. At the end of this time ulcers formed on both legs and have been present ever since, almost healing at times and then breaking down again. His general condition, however, has slowly improved, and he has been able to be up and about and to do light work.

The attacks of chills and fever have been more frequent since the

¹ Gaz. hebdom., 1871, viii.

onset of his present illness. During these attacks the temperature rises to 102° or 103° , and is accompanied by a shaking chill, headache, and nausea. The attack is generally over in twenty-four hours. On March 26 the patient fell while walking, and strained his left side in the loin. Shortly after this the legs increased in size and he began to have a septic temperature, with daily elevations of 102° to 103° . He is at present confined to his bed.

The patient is a stout well-built man, pale, and anemic. The heart and lungs are normal. The arteries are not thickened. The lower border of the liver is not palpable, but on percussion the dullness extends 10 cm. below the costal margin in the mammary line. The spleen is not palpable, and by percussion does not appear to be enlarged. The abdomen is symmetrical and slightly distended, but no masses can be felt. The superficial veins are distended on the left side, being tortuous, elevated above the surface, and easily palpable (Figs. 1 and 2). The veins are also enlarged in the left groin and extend upward, and, gradually diminishing in size, communicate with the terminal branches of the internal mammary vein. When compressed they fill from below. The deep epigastric and superficial circumflex iliac veins form a compensatory circulation with the deep epigastric and lumbar veins above. The veins on the right side of the abdomen are also dilated, but to a lesser degree. They can be distinctly seen running tortuously beneath the skin, but are not easily palpable. It is impossible to determine whether the veins are dilated in the right groin or not, due to the great swelling and induration of the leg.

The left leg is swollen to the level of the knee, the skin is tense, and on palpation the tissues are indurated and hard. In the middle portion of the leg are scars of former ulcers, and an ulcer of small dimensions is there now. The right leg is swollen to the level of Poupart's ligament and is about twice its normal size. The skin is tense and firm, and there has been a proliferation of the connective tissue, giving rise to a condition of elephantiasis. Below the knee there is an ulcer discharging a purulent material and scars of former ulcers. At Poupart's ligament is a deep depression, the result of an operation to relieve pressure on the femoral vein, which it was supposed might be the cause of the obstruction to the venous return flow.

The scrotum and penis are not swollen, and rectal examination shows no masses or anything which could cause obstruction to the return of the venous blood from the legs. Hemorrhoids are present, but give no symptoms.

A blood culture, made during one of the attacks of chills and fever, remained sterile. Repeated examinations of the blood for malarial parasites were negative.

In this case the important points are that the patient, in apparently good health, suffered a sudden stoppage of the veins of the

left leg below the knee, and on the second day following a stoppage of the veins of his right leg. This caused both legs to swell: the left to the knee, the right to the groin. Subsequently a condition of elephantiasis developed with crural ulcers, and later the veins on the left side of the abdomen became dilated and tortuous.



FIG. 1



FIG. 2

Case II, showing the collateral circulation on the right side and front of the abdomen, with elephantiasis of the right leg to the groin and of the left leg to the knee.

It is fairly clear that the obstruction in the left leg was due to a thrombus. Whether this thrombus, by extension through the iliac vein into the lower vena cava, obstructed the right common iliac vein, or whether two distinct thrombi formed, one in each leg, is an open question. We are inclined to believe this latter supposition is the correct one, in view of the fact that the compensatory circulation

on the left side did not develop at once, but gradually. Assuming that at the outset there was a thrombus on both sides, in the popliteal on the left and the femoral on the right, we believe that the thrombus extended upward until at the present time it obstructs the lower part of the inferior vena cava, since otherwise there is no explanation for the establishment of the compensatory circulation between the left deep epigastric and internal mammary veins, between the hemorrhoidal veins and the portal circulation, and between the deep epigastric, lumbar, ascending lumbar, and azygos veins. The thrombus has not yet reached the level of the right spermatic vein, which empties into the inferior vena cava below the renal vein, and which, if obstructed, would cause a swelling of the scrotum.

The attack of pleurisy which occurred three weeks after the onset of the present illness can be explained by assuming that a small portion of the clot became dislodged and led to infarction of the lung, with a slight exudation on the pleural surface. The periodical attacks of chills and fever are more difficult of explanation, but, so far as can be determined, they must be due to a general infection, with periods of latency. The source and nature of the infection we have not been able to determine.

On perusal of the literature of thrombosis of the inferior vena cava, we find that the condition is not common. Krauss,² in 1894, was able to collect 102 authentic cases, and Welch³ says there are more than 140 cases on record. On the other hand, the condition appears to be not uncommon in statistics of large hospitals; presumably most of the cases receive no attention in periodic literature.

Thrombosis of bloodvessels is primarily associated with a combination of circumstances, in which three conditions stand out prominently: (1) Changes in the chemistry of the blood. These are rather indefinite and refer to certain changes in the composition of the blood, either in proteins, fibrin ferment, or antiferment, whereby the blood is made more coagulable. (2) Mechanical factors, in which a weak heart muscle and sluggish circulation play the most important part. (3) Most important of all, some injury or degenerative change in the endothelium of the bloodvessels which determines the formation of a coagulum at this point. This injury may be mechanical or may be due to the action of bacteria or their toxins. In thrombosis of the inferior vena cava the thrombus is rarely autochthonic, but usually reaches the vena cava by extension from the femoral or pelvic veins through the iliac veins, or it is associated with intra-abdominal growth. In Krause's series of 89 cases, in which the cause of the association of the thrombosis was investigated, he found: 25 cases in which the thrombus was associated with malignant growths within the abdomen; 11 cases

² Ueber Verschluss der Vena cava superior und der Vena cava inferior. Tübingen, 1891.

³ Allbutt's System of Medicine, vi, 217.

belonged to the group of marantic thrombi; 8 cases were caused by compression from without; 8 cases were traumatic; 8 cases were associated with puerperal conditions; 7 cases were secondary to phlegmasia alba dolens, ulcus cruris, etc.; 7 were cases of organized thrombosis, mostly marantic; 4 were cases of compression occlusion without thrombosis; and 9 were cases of thrombophlebitis. Malignant growths of the abdomen furnish the largest number of cases. The greater proportion of these affect the inferior vena cava by direct extension into the tissues about the vein, and 80 per cent. perforate directly into it. The primary situation of the growth is apparently of little consequence in determining the likelihood of thrombosis. Carcinoma of the kidney furnishes the largest number of cases; uterine cancer, cancer of the testes, of the liver, of the penis, or new-growths of the retroperitoneal tissues furnish examples of extension into the vein. One case of primary sarcoma of the vein is on record and one case of endothelioma.

The group of marantic thrombi is interesting. The name was first applied by Virchow to the thromboses commonly associated with anemic and cachectic states, and was supposed to be due to sluggish circulation, as well as to certain ill-defined changes in the blood. This view, however, has undergone some revision, since recent studies have shown that many of these so-called marantic thrombi contain the microorganisms of the primary disease with which they are associated. Many of them, therefore, should be classed with the group of infective phlebitis. Phthisis furnishes the largest number of instances of complicating thrombosis of the inferior vena cava, while typhoid fever, erysipelas, cancer of the stomach, influenza, and pneumonia may be the primary diseases.

Compression of the vena cava from without may cause occlusion of the vessel with or without the formation of a thrombus. It is of interest to note in this connection that in one case a pregnant uterus, in one a uterine fibroid, and in one case an ovarian cyst was the primary cause. Retroperitoneal growths, aneurysm of the abdominal aorta, syphilis of the liver, and hypertrophy of the head of the pancreas have all caused such pressure occlusion.

Thrombophlebitis of the inferior vena cava occurred but nine times. One case was caused by perforation of the vein by a needle that had been swallowed and migrated until it penetrated the vein; one case was caused by an extension upward from a thrombophlebitis of the uterine veins caused by a pessary; one case followed a urethral blenorrhœa.

Reviewing, then, the etiology, we find that thrombosis of the inferior vena cava is usually associated with malignant growths of the abdomen, with certain infectious diseases, with septic conditions, and with trauma.

SYMPTOMS. In considering the symptoms of the thromboses, we can conveniently divide the cases into three varieties: (1) Cases in

marantic and cachectic individuals in whom autopsy reveals an antemortem thrombosis of the inferior vena cava, but in whom there were no symptoms during life to call attention to the condition. (2) Cases of partial thrombosis, or of very slowly developing thrombosis. In this interesting group fall those cases of thrombosis of the vena cava in which no symptoms reveal themselves; and it is not until the establishment of the collateral circulation or autopsy that the diagnosis can be made. The most famous case in this second group is that of Quincke,³ in which, postmortem, the vena cava was found obliterated. During life there was no cyanosis, no œdema of the legs or abdomen, no dilated superficial veins in evidence, and even at the autopsy no definite collateral circulation could be demonstrated. Another interesting case was reported by Warred,⁴ in which the inferior vena cava was congenitally thrombosed. Betz⁵ reported the case of a male, aged twenty-one years, suddenly dead of acute abdominal disorder, in which the inferior vena cava was found thrombosed with the establishment of a compensatory collateral circulation. The occlusion of the vein was considered to have been congenital. (3) In the third group fall the greater number of cases in which definite evidence of obstruction is present and in which the diagnosis can be made with reasonable confidence. As early as 1840 Rennart, and in 1860 B. Cohn, endeavored by experimental occlusion of the inferior vena cava in dogs to study the effect of such occlusions on the circulation. Their results, however, were so inconstant and inconclusive that the experiments were abandoned. We must, then, be satisfied with the studies of case reports and make allowances for the variations and inconsistencies of the symptoms.

Pain is a rather constant symptom. Its location, as well as the severity varies. Since the circulatory effect of the thrombosis is first manifested in the legs, pain in the legs is most frequently noted; next in order of frequency in the lower abdomen. On the other hand, some patients complain of no particular pain, except the soreness and tenseness due to the œdema and distention. A. Robin regarded pain in the lumbar region with prostration and tenderness about the navel as rather characteristic of thrombosis of the inferior vena cava. On the whole, pain is of little value in the diagnosis. It was mentioned occurring in the legs fifteen times, and in the abdomen sixteen times in Krause's series.

Objectively the most important symptom is œdema of the legs, genitalia, etc., in the region drained by the inferior vena cava. The development of this œdema depends upon the suddenness and degree of closure of the vein, the facility with which the collateral circulation is established, and the condition of the circulatory system

³ Von Ziemssen's Handbook, vol. vi.

⁴ Dublin Medical Journal, lxxv, 36.

⁵ Virchow-Kirsch, Jahresbericht, 1877.

of the patient. The œdema is usually bilateral. Schlesinger,⁶ on the contrary, was able to collect out of 120 cases 18 in which the swelling was principally one-sided, but in which an autopsy revealed complete closure of the inferior vena cava. The only explanation of this one-sided œdema is either a particularly rich and competent collateral venous circulation, or a possible previous disease of the iliac veins with the previous establishment of a partial collateral circulation. On the other hand, œdema of the legs is not invariably present, as in the case reported by Bresler,⁷ who thought that the non-appearance of the œdema was due to the very gradual closure of the vena cava with the rapid development of a competent collateral circulation without the œdema. The œdema extends from the legs and genitals to the abdominal wall, and may in extreme cases extend to the arms, breast, face, etc. General hydrops has been observed five times, and hydrothorax twelve times. Ascites is a rather frequent accompaniment of the condition, depending largely upon the height of the thrombus and the amount of congestion of the viscera. It occurred twenty times in Krause's series. Cyanosis may accompany the œdema, depending upon the rapidity of the occlusion. It was noted by Krause eight times, but seems generally to be considered one of the most constant symptoms of the disease. It occurs particularly in the legs.

Fever is usually present, but depends rather on the primary disease, or on complications, than on the thrombosis. A few cases are on record, however, in which the fever could be explained by the thrombosis. Robin reported a case from the study of which he concluded that a sudden high rise in temperature is rather characteristic of the thrombosis. Fever was specifically mentioned but twenty-eight times in Krause's series.

On the part of the intra-abdominal organs, objective examination reveals rather varied results. The liver may or may not be enlarged. The spleen was enlarged fourteen times. Diarrhœa occurred eighteen times, while constipation was mentioned seven times. Bloody stools occurred once. Albuminuria, regarded by Raymond as constant in thrombosis of the inferior vena cava, occurred but eight times in Krause's series and was absent in the present case. It appears that even when the renal vein is occluded the occurrence of albumin in the urine is not constant.

The most important objective symptom, and the one without which the diagnosis can never be reasonably made, is the evidence of the establishment of the collateral circulation. This means that the venous blood must reach the right auricle by means of the superior instead of the inferior vena cava. There appears to be no general rule that Nature follows to bring this about. Much depends

⁶ Zur Diagnostik der Erkrankungen der Vena cava inferior. Deut. med. Woch., 1896, xxii, 460-461.

⁷ Deut. med. Woch., 1897, xxiii, 179.

upon the thrombosis and such accidental and congenital disposition of the smaller branches of the veins as most easily to facilitate the conveyance of the blood from one system to the other. The main channels through which this is brought about is by way of the superficial epigastric and superficial circumflex iliac branches of the femoral below, and the long thoracic, a branch of the axillary, in front, and some anastomosing branches of the lumbovertebralis behind. A general idea of the appearance of the collateral circulation may be gained from the photograph of Case II of the present report.

It is self-evident that the prognosis of these cases is necessarily grave and depends on the primary disease with which it is associated. All the cancer cases (25 per cent.) die. Of the marantic thrombi group, nearly all die, associated, as they are, with unusually severe antecedent disease. In the other group, the mortality depends entirely upon the general condition and resistance of the patient and the facility with which the collateral circulation is established. A complication to be feared is pulmonary embolism. The duration of the disease is roughly one or two months. On the other hand, some patients do recover. Bresler reported a case with recovery after typhoid fever. Thompson⁸ reported a case that died on the fifty-ninth day. Jobert reported a case that was alive four years after the onset of thrombosis, while Bates reported a case of congenital thrombosis of the inferior vena cava that lived twenty-one years; so that recovery does occasionally occur, although so rarely as to be almost accidental.

COMPLETE AURICULOVENTRICULAR DISSOCIATION WITHOUT SYNCPAL OR EPILEPTIFORM ATTACKS.

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THE earliest recorded observation that I could find of what we may believe was an instance of auriculoventricular dissociation is contained in a paper by Mayo¹ (1838). In this paper is described the case of a man, aged fifty-two years, who suffered from attacks of vertigo and epileptiform seizures and who had a very slow pulse (21 to 34). Mayo noticed that there was a time "when two imperfect actions of the ventricles could be heard between stronger ones which alone were attended with a pulse at the wrist." The next observation is found in Stokes'² well-known paper (1846). His patient had a slow pulse (28 to 40) and was afflicted with apoplecti-

⁸ Trans. Clin. Soc., vol. viii.

¹ London Med. Gaz., 1838, xxii, 232.

² Dublin Quart. Jour. Med. Sci, 1846, ii, 73.

form attacks which were not followed by paralysis. In this case there were pulsations in the right jugular vein, and Stokes noted that these pulsations were more than twice as frequent as "the manifest ventricular contractions."

Cases of the same character were recorded by Blondeau³ in his thesis (1879). Chauveau,⁴ in 1885, made the first graphic records of the movements of the heart in auriculoventricular dissociation. It was not until after a number of years had elapsed, and His⁵ had reported his case of "heart-block" (1899), that interest in the matter was awakened. From experimental knowledge he inferred that the condition, as found in man, might be due, among other possible causes, to injury to the bundle of muscle fibers which connects auricles to ventricles. This bundle was described by Paladino⁶ in 1876, and subsequently by Stanley Kent,⁷ His⁸ and others.

All of the above instances of heart-block are cases which presented during life the symptom-complex named by Huchard⁹ "Adams-Stokes disease," in honor of the two Dublin physicians whom he credited with the original descriptions of the affection. Cases of permanently slow pulse in which certain nervous phenomena appear, such as recurring attacks of vertigo, syncope, and epileptiform or apoplectiform seizures, are found much earlier in the literature. Two typical cases are described at length in Morgagni's¹⁰ "De sedibus

³ Thèse de Paris, 1879.

⁴ De la dissociation du rythme auriculaire et du rythme ventriculaire. Rev. de méd., 1885, 161 (Figuier's case).

⁵ Deut. Arch. f. klin. med, 1899, lxiv, 316.

⁶ Berl. klin. Woch., 1908, xlv, 861.

⁷ Jour. phys., 1893, xiv, 233.

⁸ Wien. med. Blätter, 1894, xvii, 653; Centralbl. f. Physiol., 1895-96, ix, 469.

⁹ Traité clinique des maladies du cœur et de l'aorte. Paris, 1899, 3è éd., i, 395.

¹⁰ Morgagni, J. B. De sedibus et causis morborum, etc., Venitiis, 1761. Book I, Letter IX, Art. 7. Ad quod ut redeam; perstringam paucis, quantum potero, quæ multa ac diu in cive meo Anastasio Poggio, gravi, proboque Sacerdote animadverti. Agebat is annum duodecesuagesimum, subpingui habitu, et florido colore, præditus, cum primum comitiali morbo correptus est, qui summam pulsum raritatem, itemque corporis perfrigerationem post se reliquit. Sed hæc intra horas septem victa est, nec, sæpius redeunte morbo, amplius rediit: illa usque perstitit. Prima epilepsia dolori successerat hypochondrii dexteri, per biliosas dejectiones soluto: cæteræ, quæ leviores erant, fere succedebant sensui cujusdam quasi fumi ad caput ascendentis ex hypochondriis quorum turgentia assidue ægro molesta erat, et facile ab assumptis, liquidis præfertim, augebatur.

Letter LXIV, Art. 5.

Mercator erat Pativii annos natus quatuor et sexaginta, quadrata statura, et obeso, non tamen nimium, corporis habitu. Is olim rheumati, et nervorum contractionibus cum esset obnoxius, Medicis auxiliis sanatus fuerat, ut quamvis pluribus, variis que negotiis assidue distineretur, valeret tamen ad eam usque ætatem quæ modo indicata est cum improvise ea acciderunt, unde vehementissimis animi affectibus terrore, timore, ira que deinde, et mæstitia corripiretur. Paucis post hæc diebus, quadam ingruente quasi vertigine, cecidit. Postridie autem motibus convulsivi cum insultu, epileptici simili, vexari cepit. Is erat brevis, sed frequens, et ructibus foetidis erumpentibus solvebatur, subsequente faciei interdum rubore, interdum pallore, sensu autem angustię faucium, et ventriculi perpetuo gravis. Erant pulsus eo tempore validi quidem, sed duri, et rari: alvus autem, et vesica perpaucæ redebant.

. . . Hæc menses perstitit circiter quatuor donec post brevem ambulationem, et scalaram ascendum, priores illi convulsivi insultus, rarioses tamen, et breviores, invadere iterum cœperunt, et pulsum raritatem reducere. Mensis tum erat December. A quo tempore usque ad Junii initium cum morbus vinci non posset, tunc ego consulendi causa accersitus, et ea quæ tibi hactenus descripsi, audiui, et ægrum qualem ex memorata Epistola cognoscere potes, inveni. Raritas præcipue pulsum illa tanta, ut eorum numerus duabis circiter tertiis partibus minor esset quam oporteret, cum inculcabatur, tum a me quoque reperiebatur.

et causis morborum" (1761). The first one is recorded in Book I, Letter IX, Art. 7; the case is that of a "worthy priest of moderately fat habit and florid complexion, who in his sixty-eighth year was attacked by epilepsy, which left behind it the greatest slowness of pulse and in like manner a coldness of the body." The second case is found in Letter LXIV, Art. 5; the patient, who was sixty-four years old, had repeated attacks of vertigo and epileptiform convulsions, with "pulse two-thirds less than its natural frequency." I have also found another early description of the so-called Adams-Stokes syndrome, in a paper by Spens¹¹ (1792).

Since His' report progress in the study of heart-block has been rapid. The experiments of Humblet,¹² Hering,¹³ and Erlanger¹⁴ on the mammalian heart have been so often recounted that they have become common knowledge. The anatomical data concerning the auriculoventricular connecting bundle of muscle fibers (the bundle of His) have been completed by Tawara,¹⁵ Fahr,¹⁶ and others. Finally, a number of well-studied cases of heart-block occurring in man under various pathological conditions is on record. In some instances the clinical and, incidentally, the experimental findings were controlled by a postmortem examination of the organs which experiment has shown are susceptible of being incriminated.

Complete auriculoventricular dissociation is not of frequent occurrence, although it is possible that a systematic examination of every case of slow pulse by graphic methods or by radioscopy may somewhat raise its incidence. It is then partly on account of the comparative rarity of this affection and the associated desire to add to our knowledge of it, and partly because of certain uncommon features of the case, that the following clinical study is reported:

The patient, M. M., is a woman, aged thirty-five years, single, white, and a hosiery mender by occupation. Her father died at the age of forty-one years of tuberculosis. The mother is living, aged sixty-seven years, and in good health; she has on the left side of the face, in the neighborhood of the parotid gland, a hard growth the size of a large egg. One brother is living, aged forty years. He is said to be suffering from "kidney trouble."

The patient had measles and mumps during childhood. She states that she has been suffering from indigestion for the past fifteen years. Menstruation began at the age of fourteen; the menses are regular but painful. The pain begins two or three days before and persists

¹¹ Med. Comment., 1792, Edinb., 1793, decade 2, vii, 458.

¹² Arch. intern. d. phys., 1904, i, 278.

¹³ Arch. f. d. ges. Phys., 1905, cvii, 97; *ibid.*, 1905, cviii, 267.

¹⁴ Jour. Exper. Med., 1905, vi, 676; 1906, viii, 8.

¹⁵ Das Reizleitungssystem des Säugetierherzens. Eine anatomisch-histologische Studie über das Atrioventricularbündel und die Purkinjeschen Fäden. Jena, 1906, G. Fischer, 209 pp.

¹⁶ Münch. med. Woch., 1907, liv, 636; Virchow's Arch., 1907, clxxxviii, 562.

during and sometimes for a few days after the cessation of the flow. Menstruation lasts one week, and is usually profuse. She gave birth thirteen years ago to a healthy child at full term. The pregnancy and puerperium were uneventful; she states, however, that her health has not been good since that time. No information concerning the subsequent health of the child is obtainable, owing to the fact that she kept it only three days. She has had a leukorrheal discharge for ten years. She also has a uterine displacement, for which she has been wearing a ring pessary during the past three years. Definite evidence pointing toward syphilitic infection could not be obtained.

The patient first applied for treatment on June 27, 1908, at which time a tracing was taken, to which reference will be made later. She was admitted to the wards on July 7, 1908, in the service of Prof. H. A. Hare, to whom I am indebted for the privilege of reporting the case. I wish here also to express my indebtedness to Dr. J. C. DaCosta, Jr., and Dr. F. J. Kaltefleiter for the use of clinical notes they were kind enough to make.

Present Illness. (July 7, 1908.) The patient began nine months ago (October, 1907) to suffer from pain in the back, indigestion, and bearing down sensations in the pelvis. She went to a physician, who told her that she had an ovarian cyst, and advised operation. Previous to reaching this decision, he examined her heart and pronounced it in good condition. She, however, refused her consent to an operation; the physician then prescribed for her, giving her a liquid medicine (drops) and pills. The patient claims that the first of these medicaments made her worse. In a week she was short of breath, had pain in the abdomen followed by diarrhœa; she also had flushes of heat and numbness of the extremities. While working in the mill she had, in the pelvis, a peculiar sensation which she describes as "pulling," but which was unattended by pain; at the same time she had palpitation of the heart. Her shortness of breath became intensified and developed into orthopnœa. She stayed in bed at that time for two days, and, according to her own statement, has not been able to work since. She then complained of aching in the limbs and of more or less generalized pain; she also began to have creeping sensations throughout the body. The patient then consulted another physician, who advised exercise in the open air. The walking, however, induced precordial and substernal pain and a "giving way" sensation in the region of the heart. She also experienced now for the first time the feeling of a lump in the throat. She then went to a third physician (about April, 1908), who first spoke of her slow heart action.

The patient at the present time shows no evidence of dyspnœa, and, while not feeling very strong, is quite able to go about. She is of a diffident and rather pessimistic disposition. She denies having ever fainted or having had convulsions, and inquiry from her mother and intimate friends confirms this statement.

Examination. The patient is fairly well developed, of medium height, and in a poor state of nutrition.

The apex beat is visible and palpable in the left fifth intercostal space in the midclavicular line. There is with each heart beat a distinct heaving of the left side of the chest anteriorly, most marked near the sternum. At a point above and to the inner side of the apex light impulses may be felt in the periods between two systoles. These light impulses vary from two to three, and do not always occupy the same relative position in diastole. Now and again the apex beat is more forcible. The heart's action is slow, 30 to 36, rhythmic, and powerful. The area of cardiac dullness is slightly increased to the left.

On auscultation, a very soft, blowing murmur is heard at the apex; it is systolic in time, of brief duration, and transmitted for a short distance toward the axilla. At the same place where the light impulses above mentioned can be felt, faint, muffled sounds of a very low pitch can sometimes be heard. They are the acoustic equivalents of the light impulses felt during the diastolic period of the heart. They are best heard with the patient placed in the left lateral position. Occasionally the first sound is abnormally loud and harsh, and this coincides with the forcible apex beat mentioned above. There is reduplication of the second sound. The pulmonic second sound is moderately accentuated. The tricuspid sound is apparently normal.

One radial pulse follows each ventricular beat. The radial arteries are soft and compressible. There is no arteriosclerosis of the peripheral arteries. The pulse is infrequent and rhythmic; is rather small, rises quickly under the finger, and falls gradually. The jugular veins pulsate visibly, but only when the patient is in a recumbent posture. Their pulsations extend the whole length of the neck, and are most noticeable on the right side; the veins, however, do not seem unusually distended. The pulsations occur in quick, undulatory rises and falls, which are quite regular and are about three times as frequent as those of the carotid pulse; they bear a definite relation to the light impulses which can be felt over the heart. A better understanding of these pulsations, which were undoubtedly due to auricular contractions, will be obtained through the description of the tracings which accompany this paper.

The systolic pressure is 125 mm. Hg., and the diastolic pressure 80 mm. Hg. (Stanton's instrument).

The pupils react to light and accommodation. The ocular movements are not limited. The conjunctiva and sclera are normal in appearance. There is no strabismus, no ptosis. The media are clear. There is slight oedema of the retina. The arteries are small, the veins not much distended. The field of vision for white and colors shows nothing noteworthy (Dr. Le Fevre).

There are no cutaneous areas of paresthesia, no painful spots; the

corneal sensibility is normal, the pharyngeal sensibility slightly diminished. Babinski's sign and Gordon's paradoxical reflex are absent on both sides. The knee jerks are slightly increased on both sides.

The abdomen shows nothing noteworthy. The uterine displacement mentioned above is a retroflexion (Dr. Heineberg). There is no œdema of the lower extremities. The urine and blood are normal.

The subsequent history of the patient can be summarized in a few words. She remained in the hospital about nine weeks. She was at first very nervous and cried on the least provocation; the administration of sodium bromide for a few days disposed definitely of this element. Her most constant complaint was that of a "pulling down sensation with each heart beat" and of a lump both in the throat and at the lower part of the sternum. The tugging or bumping sensation about the heart, as she variously described it, distressed her most. She claimed that she suffered a great deal from it, but her appearance certainly did not support her statements. Numerous counts of the radial pulse showed that the prevailing frequency was 32 to 36. The records show that it was once as high as 54 and at another time as low as 26; it was at all times quite regular and was not influenced by posture or emotional disturbances; neither did deep pressure over the vagus have any effect upon it. With the patient in the recumbent posture the jugular veins could always be seen to pulsate 2 to 3 times as frequently as the carotids. The feeble pulsations felt between two systoles and the corresponding faint sounds heard on auscultation varied much in their intensity from day to day, so much so that on certain occasions these phenomena could not be observed. It may be said that they were best marked during the first weeks of the patient's stay in the hospital.

To recapitulate the clinical history of the case, briefly: The patient is an unmarried woman, aged thirty-five years, having, thirteen years ago, given birth to a presumably healthy child. About six months before applying for treatment at the hospital she suffered from intense dyspnoea, which in all probability was of cardiac origin. She presents now symptoms suggestive of neurasthenia. She has a permanently infrequent pulse; there is a systolic murmur at the mitral area, and faint distant sounds are occasionally heard in diastole. On such occasions light impulses may be felt a little above and within the apex.

When the patient first presented herself for examination it was thought that the peculiar action of her heart was produced by extrasystolic irregularity, and that the bradycardia was due to the failure of some of the extrasystoles to give rise to a pulse in the arteries. A simultaneous tracing of the apex beat, carotid and right jugular pulses was therefore taken, in order to ascertain, if possible, the cause of the bradycardia. While the tracing was being taken the patient became very nervous, and her efforts to check an oncoming fit of

crying caused such heavings of her chest as to deform badly the tracing obtained from the apex beat. The carotid and jugular tracings were, however, quite legible, and through these the ventricular systoles could be reconstructed. An analysis of this tracing demonstrates that the ventricular action was infrequent and regular, that there were from two to three auricular contractions to one ventricular, and that auricles and ventricles were beating independently of each other; in other words, the tracing shows complete *a-v* dissociation. The bradycardia was due to the failure on the part of the auricles to excite the ventricles to contraction: there was, therefore, a condition of heart-block. The following table, after the manner of Erlanger, shows the relative frequency of auricles to ventricles at that time.

M. M., JUNE 28, 1908.

No. of Vs.	Duration in $\frac{1}{10}$ sec. ¹⁷	Vs. rate per min.	No. of As.	Duration in $\frac{1}{10}$ sec.	As. rate per min.	As. to Vs.
7	114	33	19	114	90	2.7 to 1

Owing to unavoidable circumstances, I was unable to take any more tracings until August 1, following. In the time which had elapsed since her admission the patient had become a great deal more composed, and under the influence of rest and bromides had become decidedly less nervous. A very satisfactory tracing (Fig. 1) was taken under these circumstances. The ventricular and pulse rate was 33; the auricular (jugular) rate was 100. The tracing records the simultaneous movements of the cardiac apex, the carotid artery, and the right jugular vein. The tracing shows that the ventricular contractions are regular, and that each ventricular systole is followed by an arterial pulse. It will be observed that two small waves are present in each diastolic period. These small waves (*a*) correspond to similar waves in the jugular tracing, and are due to auricular contractions. It will be seen also that the systolic plateau varies with each succeeding systole, becoming gradually more and more deformed as the tracing proceeds. A careful comparison of the jugular and apex tracings shows that the amount of deformity of the systolic plateau depends on the time of occurrence of one of the auricular contractions, as shown in the jugular tracing, viz., the first in each ventricular cycle. The earlier this auricular contraction occurs in the period in which the systolic plateau is produced the more deformed the latter becomes. The abnormally loud and harsh first sound mentioned in the patient's

¹⁷ Some discrepancies having been found between the pulse rate as counted by the finger and as counted by the time markings at the bottom of the tracings, I was led to test the time-marking apparatus, and found that each interruption equalled $\frac{1}{9}$ sec. instead of $\frac{1}{10}$ sec., as indicated on the tracings.

history was possibly due to an auricular contraction occurring soon after the ventricles had begun to contract. An examination of the rest of the tracing, of which Fig. 1 is the part immediately preceding, shows that the following systolic plateau is not quite as deformed as

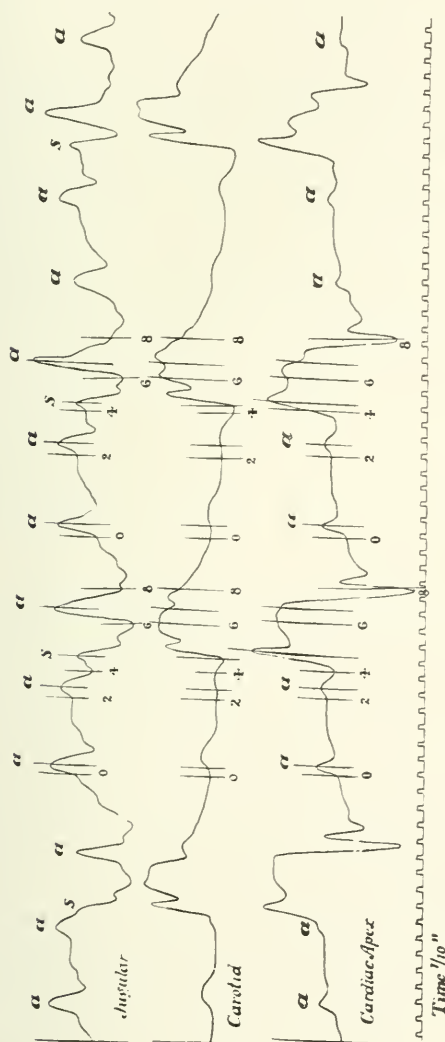


FIG. 1.—Simultaneous tracings of pulsations in the right jugular vein and carotid artery, and of the apex beat. Note that while only two auricular waves are seen in the curve taken from the cardiac apex, there are three auricular waves in the jugular curve.

the last one the tracing here reproduced, and that the succeeding ones gradually assume a normal appearance. This change coincides with the progressive advance of the first auricular systole in each ventricular cycle toward the ventricular diastole. From what has just been said, it is evident that no reliance can be placed in the

cardiogram alone as a means of estimating the number of auricular contractions.

The carotid tracing has on the katacrotic limb a number of abnormal waves. Such waves on the arterial pulse, in cases of heart-block, have been described by Erlanger,¹⁸ Mackenzie,¹⁹ and others, and have been thought by them to be intrinsic in the artery. In the case here presented, however, the waves in question are of extraneous origin and are due to the fact that it was impossible to place the receiver so that the jugular pulsations would be completely cut off. The record of the carotid pulsations was accordingly vitiated. That these adventitious waves occur later than the corresponding true waves on the cardiogram and jugular tracing is attributable to the circumstance that the receiver for the carotid was placed higher on the neck than the one for the jugular vein; the difference in time represents the time lost in the propagation of the venous wave. A tracing obtained from the radial (Fig. 2) shows no evidence of abnormal waves on the katacrotic limb of the pulse.

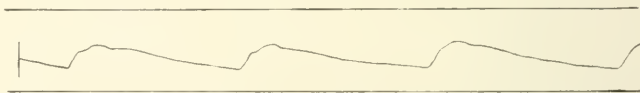


FIG. 2.—Tracing obtained from the right radial artery. There are no abnormal waves on the katacrotic limb of the pulse wave as seen in the other tracings obtained from the carotid artery.

In the jugular tracing the waves marked *a* represent auricular contractions; the wave *s* occurs in the presphygmic period of the ventricular contraction, and is due to the sudden pushing up of the closed tricuspid valve during the rapid rise of intraventricular pressure immediately preceding the opening of the semilunar valves; it is the *c* wave of Mackenzie, and the neighboring carotid artery may contribute in its formation. It will be noted that there are three auricular to one ventricular contraction and that the auricular cycles are quite regular in time, each one occupying about five-tenths of a second. The auricular rhythm, however, bears no relation to the ventricular rhythm. The second auricular contraction on the tracing occurs at a time when the ventricle was just beginning to contract; the distance between each auricular contraction occupying a corresponding place in the ventricular cycle and the following ventricular systole is then seen to increase gradually, and an analysis of the continuation of the same tracing shows that this goes on for one more cycle, when the distance under consideration gradually diminishes until in four ventricular cycles one auricular contraction again falls in the beginning of the ventricular systole. The other auricular contractions shift their position accordingly. In this respect the auricular contraction, which, as mentioned above, caused the systolic

¹⁸ Loc cit.

¹⁹ Brit. Med. Jour., 1906, ii, 1107.

plateau of the ventricular systoles to be deformed, deserves a few words of description. At first glance it might be thought to be the *v* wave found in any negative venous pulse. The mere fact that it changes its position with each succeeding ventricular cycle shows that this cannot be the case; moreover, the wave under discussion bears little or no morphological resemblance to a true *v* wave. Its abrupt anacrotic limb shows that it is due to some suddenly acting force, which I believe is a contraction of the right auricle. This wave also varies in size in the succeeding cycles and in such a manner that it is relatively large when the auricular contraction occurs while the ventricles are contracting, and is relatively small (as at *a'*) when the auricle contracts while the ventricle has just entered in diastole and the auriculoventricular valves are opening. The factors which ordinarily give rise to the *v* wave are no doubt present, and so may add themselves to the auricular contraction in producing a wave of great amplitude. In those instances in which no auricular contraction interferes with its formation the *v* wave makes its appearance (see Figs, 3, 5, 7, 10). An incomplete blending of the *v* and *a* waves is beautifully illustrated in Fig. 6, which is part of a tracing taken five minutes after tracing Fig. 5.

The following table gives the auricular and ventricular rates obtained from tracings taken at a few days' interval and at the time the patient was receiving sodium bromide:

Date.	No. of Vs.	Duration in $\frac{1}{9}$ sec.	Vs. rate per min.	No. of As.	Duration in $\frac{1}{9}$ sec.	As. rate per min.	As. to Vs.
8-1-'08 (Fig. 1)	11	179.5	32.8	35	187.5	100.8	3.07 to 1
8-3-'08	13	203.0	34.5	41	233.0	95.0	2.75 to 1
8-7-'08	14	190.0	39.7	48	205.0	126.4	3.1 to 1
Average.	..	...	35.6	..	...	107.1	2.97 to 1

The patient then, as shown above, presents the phenomenon of complete auriculoventricular dissociation. She therefore afforded an excellent opportunity for the study of drugs which are known to act on the heart. Among these, digitalis and strophanthus are probably the most important. Digitalis has, however, been thoroughly investigated, and almost, if not all, therapeutists are agreed as to the essential manner of action of the drug. The same cannot be said of strophanthus, some therapeutists contending that this drug acts upon the heart in a manner identical to that of digitalis, while others believe that its inhibiting action is not due to a vagus effect, but to a direct influence on the cardiac muscle. So far as I am aware, the effects which follow the administration of strophanthus in heart-block have never been recorded. The only work of a similar nature is that of von Tabora.²⁰ This investigator

²⁰ Ztschr. f. exper. Path. u. Ther., 1906, iii, 549.

experimented on dogs, and after producing complete and lasting dissociation by crushing the *a-v* bundle, injected digitalin intra-

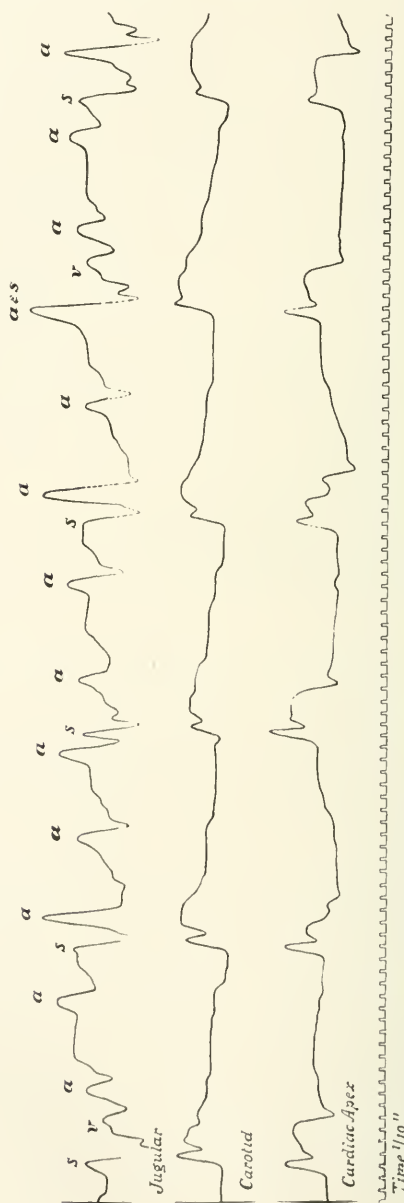


FIG. 3.—Effect of strophanthine. The auricular frequency is diminished in that two and three auricular contractions occur alternately in succeeding ventricular cycles instead of three in each such cycle, as seen in Fig. 1.

venously. Under these circumstances the frequency of the automatically beating ventricles is doubled, while the auricular frequency,

which at first is unaffected, decreases gradually until finally the auricles stop beating; the ventricles go on beating at their high rate.

The patient was, therefore, given 5 minims of the tincture of strophanthus three times a day, and a few days later tracings were taken

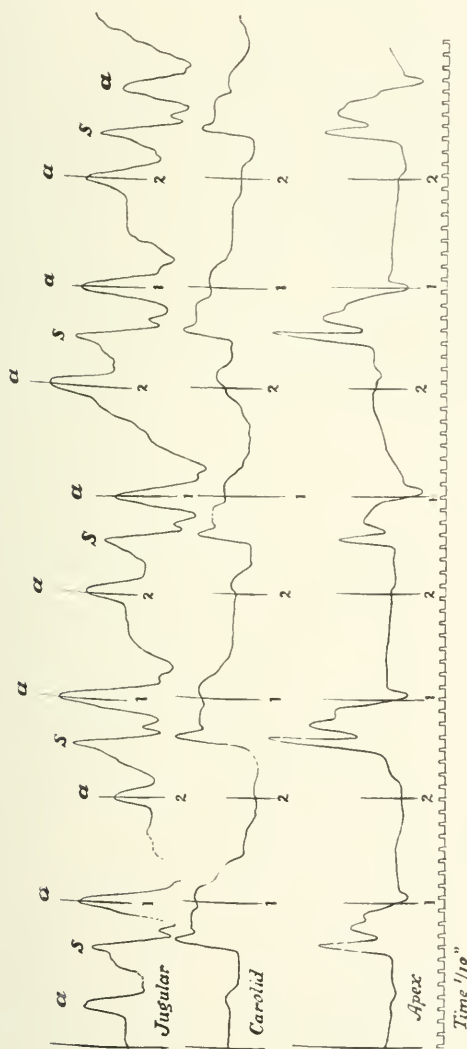


FIG. 4.—Further effect of strophanthus: An apparent 2 to 1 rhythm with, however, greatly prolonged intersystolic period.

to determine the reaction of the auricles and ventricles to the drug.²¹ The first noticeable effect was obtained after nine days of the admin-

²¹ As a matter of caution, it was deemed safer to give small doses by mouth at regular intervals than to administer a single relatively large dose hypodermically, although the latter might possibly have been more interesting in its results.

istration of strophanthus in the dose mentioned above. From a 3 to 1 ratio (with complete dissociation) the heart's action had changed

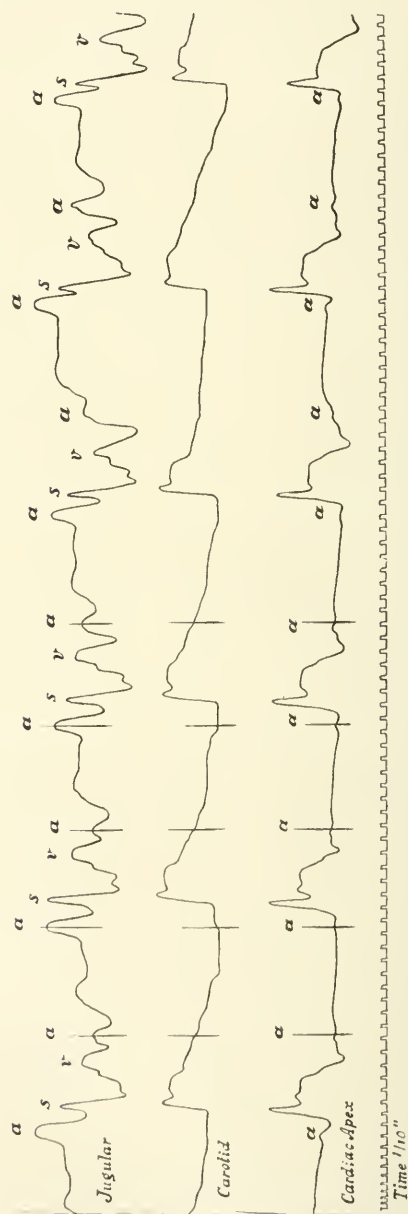


Fig. 5.—Same as Fig. 4. Here, however, the resemblance to a 2 to 1 rhythm of incomplete heart-block is still more striking.

to an alternate 2 to 1 and 3 to 1 ratio, complete dissociation still persisting (Fig. 3). Four days later the $a-v$ ratio was 2 to 1 (Fig. 4).

Dissociation of auriculoventricular rhythm was still present, but it was apparently of a lower grade, and every other auricular contraction was followed by a ventricular contraction, although, if any impulse was transmitted from auricles to ventricles, the time occupied in its transmission was abnormally great (about four-tenths second). Another tracing taken on the same day shows in the last three ventricular cycles, at least, a typical 2 to 1 rhythm (Fig. 5). The features of an incomplete *a-v* dissociation with a 2 to 1 rhythm, as shown in Figs. 4 and 5, are, however, only apparent and are the consequence of a fortuitous adaptation of the auricular to the ventricular rhythm under the slowing action of strophanthus on the auricles. In support of this view, Erlanger's²² experiments may be cited. This observer found that when the block between auricles and ventricles is not complete, but owing to the relatively high auricular rate the *a-v* dissociation is complete, a slowing of the auricular rate by any appropriate means will be followed by 3 to 1, 2 to 1, or even normal rhythms; but under these circumstances the rate of the ventricles increases suddenly with each variation in the rhythm. The table which follows shows that the ventricular rate was not materially affected by the change in the rate of the auricular contractions.

AURICULAR AND VENTRICULAR RHYTHMS UNDER THE INFLUENCE OF STROPHANTHUS.

Date.	No. of Vs.	Duration in $\frac{1}{9}$ sec.	Vs. rate per min.	No. of As.	Duration in $\frac{1}{9}$ sec.	As. rate per min.	As. : Vs.
8-24-'08 (Fig. 4)	11	186.0	32.0	27	191.5	76.0	2.3 to 1
8-28-'08 11 A.M.	8	124.0	34.8	18	136.0	71.0	2.0 to 1
8-28-'08 11.10	6	102.0	31.76	14	116.0	65.1	2.0 to 1
8-28-'08 11.20	8	132.0	32.72	18	148.0	65.94	2.0 to 1
8-28-'08 11.30	8	132.0	32.72	20	152.0	71.05	2.17 to 1
8-28-'08 12 M.	8	130.0	33.23	16	132.0	65.44	2.0 to 1
8-28-'08 (Fig. 5) 12.05 P.M.	5	77.5	34.8	10	78.0	69.2	2.0 to 1
8-28-'08 (Fig. 6) 12.10 P.M.	6	96.0	33.7	12	95.0	68.2	2.0 to 1
Average.	..	...	33.2	..	...	68.9	2.07 to 1

From the facts adduced above, we might feel justified to infer that the block between auricles and ventricles is, in this case, complete. I will later bring additional evidence to prove that this inference is in all probability correct. The same facts, namely, a slowing of the auricular rate, the ventricular rate remaining practically constant, offer an explanation regarding the mode of action of strophanthus on the heart. It has been shown by Erlanger

²² Brit. Med Jour., 1906, ii, 1111.

and others that stimulation of the vagus in complete heart-block, while inhibiting the auricles in the usual way, has little or no effect on the ventricles. Conversely, removing vagus influence, as by cutting both vagi, will result in an increase in the auricular rate, the block being, of course, complete. It is, therefore, believed that the vagus acts directly on the auricles only, and that the inhibition of the ventricles, which in the normal heart follows stimulation of the vagus, is secondary to the inhibition of the auricles. The explanation of the action of strophanthus is therefore obvious, at least in so far as this instance is concerned; it slows the heart by stimulating the vagus nerve. If strophanthus slowed the heart's action by a direct effect on the muscle cell, both auricles and ventricles would have been proportionately slowed. Such, however, was not the case. It is, indeed, difficult to conceive that a drug

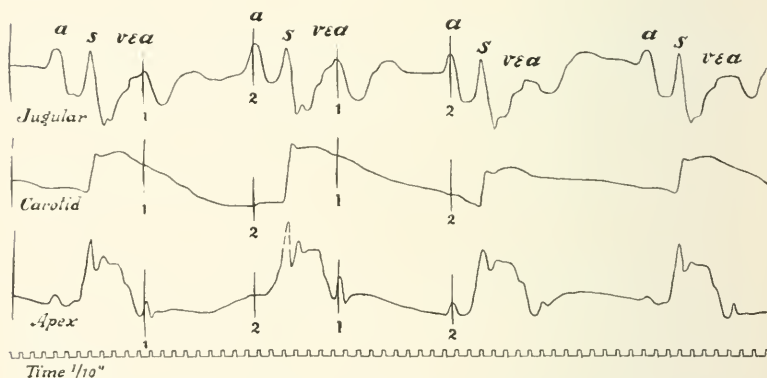


FIG. 6.—To illustrate the bending of the *v* wave with an auricular wave as the latter gradually falls into the protodiastolic period of the ventricular cycle.

could so depress the cardiac muscle as to lower the frequency of its contractions and at the same time increase the force of these contractions (which latter is generally conceded to be an effect of strophanthus). The administration of the drug was then discontinued, and an analysis of several tracings taken two days afterward showed the ventricular rate to be 31.9, the auricular rate 84.1, and the *As.* to *Vs.* ratio of 2.6 to 1. The tracing shows again complete *a-v* dissociation (Fig. 7).

From what has been said above, any agent which is known to slow the entire normal heart through vagus stimulation may be used as a means of testing the degree of heart block.

Another method of testing the extent of the block between auricles and ventricles consists in the hypodermic use of atropine. The employment of this drug was first recommended by Delio²³ as a

²³ St. Petersburg, med. Woch., 1892, xvii, 1; Deut. Arch. f. klin. med., 1893, lii, 97.

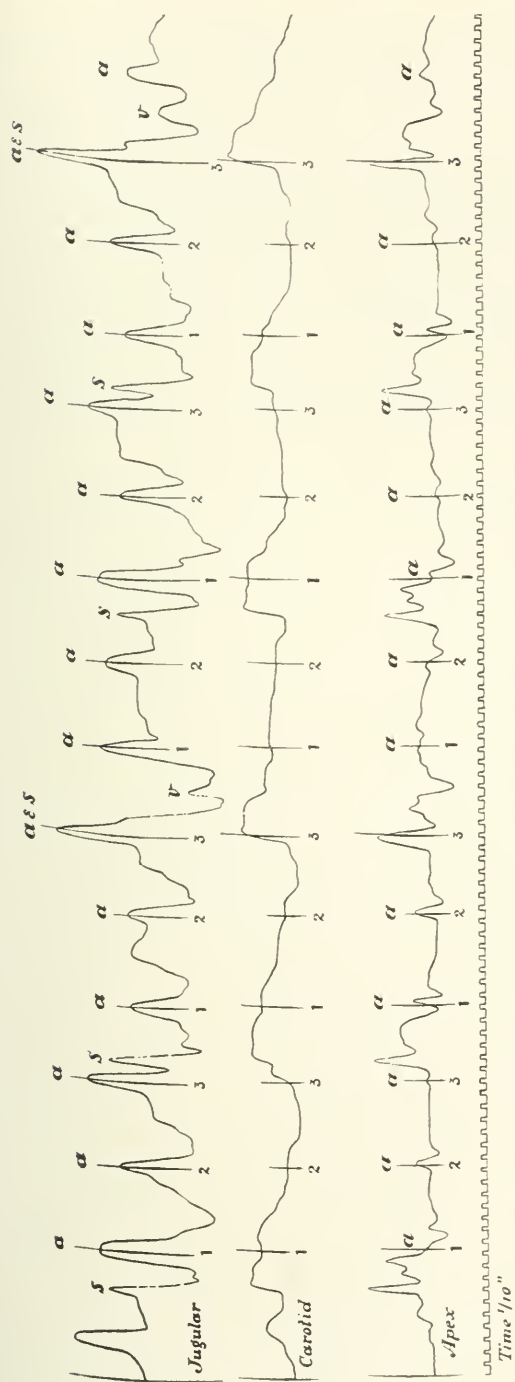


FIG. 7.—Tracing showing the effect of withdrawal of strophantodus. The auricular frequency is increased; the ventricular frequency is unaffected; the dissociation is complete.

hand (Erlanger,²⁴ Ritchie,²⁵ Gibson,²⁶ Leuchtweis,²⁷ Schmoll²⁸). Under the influence of atropine the auricular rate is more or less accelerated, while the ventricular rate is practically uninfluenced if the block is complete. If, however, the block is incomplete, some of the auricular impulses passing over to the ventricles, the latter's rate increases with the increase in the frequency of the auricular contractions. This, of course, has its explanation in what has been said previously concerning the mode of action of the vagus nerve.

The dose of atropine necessary to produce such effects must be relatively large. I tried successively and on different days doses of $\frac{1}{200}$, $\frac{1}{150}$, and $\frac{1}{100}$ grain hypodermically without appreciable results, in spite of the fact that mydriasis, flushing of the cheeks, and dryness of the throat were present in every instance. Finally $\frac{1}{50}$ grain was injected hypodermically, with the result seen in the table below:

EFFECT OF ATROPINE. $\frac{1}{50}$ GRAIN HYPODERMICALLY.

No. of min. after injection of atropine.	No. of Vs.	Duration in $\frac{1}{10}$ sec.	Vs. rate per min.	No. of As.	Duration in $\frac{1}{10}$ sec.	As. rate per min.	As. to Vs.
Before (Fig. 8)	12	205.5	31.53	30	225	72.0	2.28 to 1
10	6	96.0	33.75	18	101	96.23	2.85 to 1
20	6	92.0	35.32	20	100	108.0	3.05 to 1
25	10	160.0	33.75	36	168	115.7	3.42 to 1
35	6	89.0	36.4	22	96	123.7	3.39 to 1
45 (Fig. 9)	6	95.0	34.1	23	102	122.9	3.60 to 1
55 (Fig. 10)	6	100.0	32.4	22	106	112.0	3.36 to 1

This table shows conclusively that under the influence of atropine the auricular rate is noticeably accelerated. There is also, in this instance, a slight increase in the rate of ventricular contraction, but that this bears no direct relation to the increase in the auricular rate is shown by two facts: the gradual increase in the *As.* to *Vs.* ratio, and the return, at the close of the test, of the ventricular rate to a frequency closely approximating that obtaining at the beginning of the test, although the auricular rate is still relatively high. So far as the tracings are concerned, they all show complete dissociation; another point which is observed is the gradual diminution in the amplitude of the auricular waves as the auricular contractions increase in frequency. It will be noted that the greatest auricular acceleration occurred in thirty-five to forty-five minutes following the atropine injection. This tallies essentially with the findings of Erlanger.²⁹ Owing to the fact that the tracings were not

²⁴ Jour. Exper. Med., 1905, vii, 676.²⁵ Brit. Med. Jour., 1906, ii, 1113.²⁶ Ibid., lxxxvii, 554.²⁷ Proc. Roy. Soc. Edinb., 1905, xxv, 1085.²⁸ Deut. Arch. f. klin. med., 1906, lxxxvi, 456.²⁹ Loc cit.

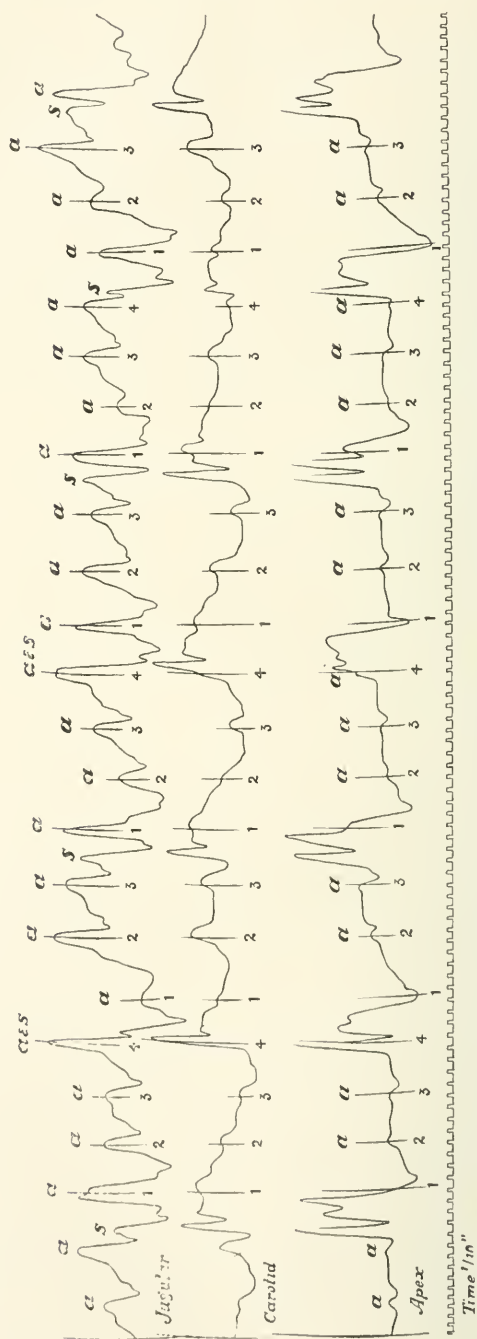


FIG. 9.—Tracing showing the effect of atropine forty-five minutes after injection. The auricular wave is distinctly accelerated; the ventricular rate practically uninfluenced. The auricular waves are of less amplitude than in Fig. 8.

taken at closer intervals, the preliminary slowing in the auricular contractions mentioned by the last-named investigator escaped notice.

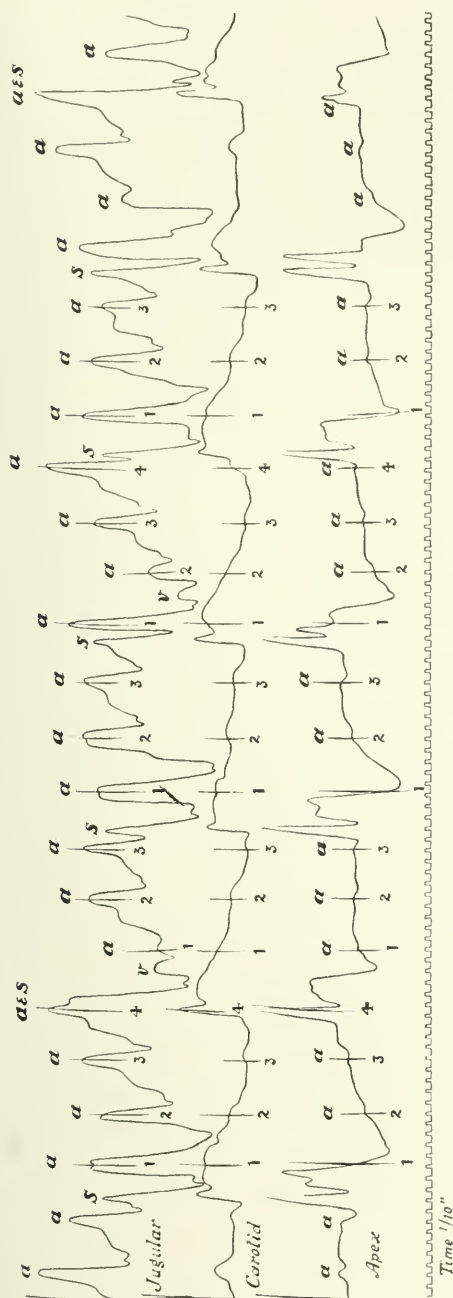


FIG. 10.—Tracing taken ten minutes later. The auricular frequency is beginning to decrease. The amplitude of the auricular waves is slightly greater than in Fig. 9.

Apart from intense dryness of the mouth and throat, the patient did not suffer any inconvenience from the test. Besides this subjective symptom, the patient had flushed cheeks and dilated pupils. It would have been interesting to observe the return of the heart's action to its former condition, but the patient, complaining of being tired, refused to submit any longer to the taking of tracings, and the test had to be discontinued.

The behavior of the heart under the influence of atropine strengthens us in the belief that the block between the auricles and the ventricles from which the patient is suffering is organic. Furthermore, the block is, in all probability, complete. If we may use the relatively few cases which, having been studied clinically, have been followed by a careful postmortem examination of the heart, and draw inferences from these, then the mere presence of complete auriculoventricular dissociation would be sufficient in itself to justify a diagnosis of profound organic change in the *a-v* bundle. (See Luce³⁰ (heart studied by Fahr³¹), Schmoll³² (Case II), Jellinek and Cooper³³ (Case I), Ashton, Norris, and Lavenson,³⁴ Karcher and Schaffner,³⁵ Stengel,³⁶ James.³⁷) There are two cases, however, which contradict this statement. One of these cases is that of Deneke,³⁸ in which there was complete dissociation and the *a-v* bundle was found to be normal, but there was dilatation of the heart and fibrous myocarditis, so that it is possible that the ultimate ramifications of the bundle into the Purkinje fibers, as described by Tawara, may have become implicated in the pathological process. The other case is one reported by Heineke, Müller and v. Hösslin;³⁹ in this instance the dissociation was partial, although later it became complete. An examination of the heart showed that there was not a vestige left of the *a-v* bundle. The patient who was the object of this investigation had suffered from this condition probably for many years (the syncopal attacks had begun thirty-five years before death). The last-named authors, therefore, think that other pathways exist and may be called into action when the main conducting system has been destroyed, or that under such a circumstance new pathways may form and transmit the excitation wave from auricles to ventricles.

The phenomenon of auriculoventricular dissociation is seldom found alone; it is generally seen in association with certain nervous disturbances, which are of varying intensity, occur in definite attacks, and are part of the symptom-complex with which the names of Adams and Stokes are connected. The number of cases of Adams-

³⁰ Deut. Arch. f. klin. Med., 1902, lxxiv.

³² Loc. cit.

³⁴ AMER. JOUR. MED. SCI., 1907, cxxxiii, 28.

³⁶ AMER. JOUR. MED. SCI., 1905, cxxx, 1083.

³⁷ Ibid., 1908, cxxxvi, 469. (In the last two cases no histological study of the *a-v* bundle has as yet been reported.)

³⁸ Arch. f. klin. Med., 1906, lxxxix, 39.

³¹ Loc. cit.

³³ Brit. Med. Jour., 1908, i, 796.

³⁵ Berl. klin. Woch., 1908, xxvii, 1266.

³⁹ Ibid., 1908, xciii, 459.

Stokes syndrome is greater than one would suppose. Beginning with Morgagni, I have been able to collect 177 cases of this symptom-complex. If we begin with Mayo, then of these 177 cases, 87 presented the evidences of auriculoventricular dissociation. The reports of these cases are, of course, of widely unequal merits, so that conclusions from these numbers should be made with caution. It is noteworthy, however, that within recent years very few cases of Adams-Stokes syndrome without heart-block have been reported. The number of cases of heart-block without attacks of vertigo, syncope, and epileptiform seizures, etc., is equally very small. In most of them the dissociation has been transient in character. It may occur in the course of an acute infection, as in influenza (MacKenzie⁴⁰), acute rheumatic fever (Joachim,⁴¹ Gerhardt⁴²), and in malignant endocarditis (James⁴³). It has been observed in failing compensation (Chauffard,⁴⁴ Gibson⁴⁵), and without evident cause (Jellinek and Cooper,⁴⁶ Case II). All of these cases recovered except Gibson's and James'. In Jellinek and Cooper's case the recovery followed the administration of potassium iodide. Both Gibson's and James' cases came to autopsy, and the findings are corroborative of the now well-established facts concerning the physiology of the *a-v* bundle. In Gibson's case, which had exhibited partial dissociation, the pericardial sac was completely obliterated, the pericardium being greatly thickened especially over the ventricles. The heart muscle was healthy, even close to the auriculoventricular bundle, but the latter was of a paler color than normal and showed cellular infiltration and a notable increase in fibrous tissue; the muscle fibers of the bundle were thereby widely separated from each other. In James' case the *a-v* dissociation was complete, and at autopsy an extensive ulcer was found in the interventricular septum, which, from its position, is thought to have destroyed the bundle; so far there has been no histological examination made.

These cases, together with the one here reported, show indubitably that heart-block with its usual bradycardia can occur independently of any nervous disturbance, which latter, as before stated, is part of the Adams-Stokes syndrome. I call attention to this fact because there has been a tendency of late to confuse and assimilate the two terms, Adams-Stokes syndrome and heart-block, as synonyms. Why attacks of vertigo, syncope, etc., should occur with certain cases of heart-block and not with others cannot as yet be satisfactorily answered. In nearly all cases of heart-block, with the Adams-Stokes syndrome, it has been observed that the attacks were immediately preceded by stoppage of the ventricles, the auricles continuing to beat regularly. The vertigo, loss of consciousness,

⁴⁰ Brit. Med. Jour., 1902, ii, 1411.

⁴¹ Zeitschr. f. klin. Med., 1907, lxiv, 95.

⁴² Arch. f. exper. Path. u. Pharm., 1904, li, 11.

⁴³ Loc. cit.

⁴⁴ Rev. gén. de clin. et de thérap., 1907, xxi, 437.

⁴⁵ Loc cit.

⁴⁶ Loc cit.

and epileptiform convulsions are therefore thought to be secondary to the arrest of the ventricles and due to anemia of the nerve centres. What the cause of ventricular stoppage is we do not know.

It may be added that the patient who is the object of this report has been receiving potassium iodide for a number of weeks, and that so far it has had no effect on the heart's action. Having had the opportunity of seeing the patient recently, I took a tracing, which on analysis showed a ventricular frequency of 36, auricular frequency of 87, and an *As.* to *Vs.* ratio of 2.4 to 1, with complete dissociation. The thought comes naturally to one's mind that this patient may sooner or later develop the full Adams-Stokes syndrome; she may also recover. Whatever will be the outcome of this disorder, there is at the present time no indication pointing one way or another. There is nothing in the patient's symptoms which would even suggest those ill-defined attacks classified by Huchard under the term *formes frustes*.

THE ORIGIN OF THE "NEW-LEATHER" AND "DRY FRICTION" SOUNDS HEARD ON AUSCULTATION.

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THE diagnostician is wont to consider the signs elicited by physical examination to be objective, mechanical, and certain in their significance; but he loses nothing in accuracy if he realizes that, after all, the interpretation of these signs is largely a work of the imagination. Listening at the telephone, we may feel positive that we identify the person whose voice we hear, and later find that another has spoken. The very terminology of auscultatory signs is a more or less unhappy train of metaphor. "Moist" and "dry" are useful, but hardly defensible adjectives. The "gallop rhythm" approaches ideal descriptiveness, and the "bruit de cuir neuf," the creaking sound made by new leather, is recognized by its quality at the first hearing. Any number of competent examiners perceiving these sounds in listening to a chest would probably agree in designating them as the "new-leather sounds." But if conclusions were ventured as to the source and significance of the signs, it is probable that the diagnostic deductions would vary widely one from the other. In my experience the new-leather sound has usually seemed to characterize certain chronic pathological pulmonary states in which extensive fibroid changes in the lungs and pleuræ were to be predicated. In certain cases the sounds appear to have their origin in the bronchial tubes and to be due to the vibrations of tenacious mucus. Sahli¹ ascribes

¹ Diagnostic Methods, Trans., p. 239.

the sounds to a pleural friction. Rosenbach² points out that the presence of tubercles, tumors, etc., in the pleura may give rise to the creaking sounds, as well as may inflammatory changes in the membrane; but he describes, also, a "pseudopleural friction rub," which has the typical creaking characters, and which, moreover, conveys to the touch a vibratile fremitus often of great intensity. This sign is, according to Rosenbach, muscular in origin, being due to contraction of the intercostal, thoracic, and dorsal muscles; it is usually symmetrical on both sides of the chest in individuals having wide intercostal spaces, and preferably affects the lower, more movable parts of the pareties and the interscapular spaces.

In a study of the inflammatory changes of the intercostal muscles accompanying infective processes in the lung and pleura, Coplin³ points out that intermuscular friction of the altered fibers could very well give rise to a wide range of pseudopleural sounds, including, especially, the *bruit de cuir neuf*. Indeed, the frequency with which the thoracic muscles show microscopic alterations as a result of pulmonary infection suggests that the auscultatory signs intrinsic in its muscular pareties may have a much more general significance in diseases of the chest than is generally attributed to them.

The excuse for the present note is a recent clinical experience in which positive proof was afforded that "new-leather sounds" as well as the "dry friction rub" may be perceived in the chest wall when there can be no suspicion of pleural friction.

Mr. M., aged twenty-seven years, a clerk, was well until about April, 1907, when he developed what was supposed to be typhoid fever. The disease failing to yield, critical examination later revealed active pulmonary tuberculosis. The patient came to Denver early in September, 1907. He was much emaciated, had diarrhœa, and manifested signs of active tuberculosis in the upper two-thirds of both lungs, with a cavity at the right apex. The heart was in the normal position, and there were no thoracic signs unusual to the condition. The patient's condition improved considerably, and he enjoyed, for the most part, freedom from all distress, except for the repeated occurrence of attacks of profuse epistaxis, until the night of November 19, when he was suddenly seized with intense pain in the left side of the chest, together with urgent air-hunger. The distress yielded to a hypodermic injection of morphine, and when I saw the patient the next morning he was comfortable.

The physical signs at this time pointed unmistakably to the development of pneumothorax of the left side. The heart appeared to be wholly to the right of the sternum. The left wall of the chest was much more prominent than the right, it was nearly immobile, the rib spaces were very wide, and there was tympany to percussion throughout the left front and side. The breath sounds were feeble

² Nothnagel's System, Diseases of Bronchi, Pleuræ, and Lungs, p. 864.

³ AMER. JOUR. MED. SCI., 1904, cxxvii, 754.

and metallic in character, but there were no signs which could have arisen from the chest wall or the pleura. The patient while completely at rest continued to enjoy extraordinary comfort until December 13, when he was again seized suddenly with a very disagreeable sensation, described as a "tightness" in the left upper part of the chest and accompanied by considerable dyspnoea. The acute distress disappeared after a few hours, when physical examination showed, as before, tympany and distention of the left side of the chest, with the addition, however, of very strong "new-leather" sounds over the whole area to the left of the sternum, extending from the first intercostal space to the sixth space and as far outward as the anterior axillary line. With respiratory motion, there was over this area, at least, close to the sternal border, marked tactile fremitus, which seemed very superficial, as if from crepitation in the chest wall itself. Subsequent examination of the patient day by day showed the gradual disappearance of the tactile fremitus except along the lower left edge of the sternum. The new-leather sounds changed their character little by little to a quality I have commonly noted as a "dry pleural friction rub." The breath sounds were faintly audible, and had lost their metallic nature. The patient continued untroubled until December 29, when, after a comfortable night, he was again suddenly attacked with air hunger, and died within an hour or two.

The autopsy revealed the following conditions: The heart was wholly to the right of the middle line, the long axis of the organ was somewhat more nearly parallel than usual to the long axis of the body. The right lung contained a considerable cavity in the apex, was nearly solid with tubercles, and was closely adherent to the chest wall. The left lung was completely collapsed and reduced to the size of one's fist. An air space three inches broad separated its surface from the thoracic wall in all directions except posteriorly. The posterior superior margin of the lung was prevented from complete collapse by long adhesions to the pleural apex. Only that part of the organ could be made to crepitate. The two lobes of the lung were tightly sealed together. Tubercles were found scattered throughout the lung, which had evidently been long in a state of collapse. The pleural surfaces did not glisten, and the *cavity contained no fluid*.

Unfortunately no microscopic examination was made to determine the tissue changes which might have given rise to the physical signs observed, but no reasonable doubt can exist that these signs, the tactile fremitus, the "new-leather" and "dry friction" sounds, had their origin in the chest wall itself, and must have been due to the rubbing together of tissue elements during respiratory movement. The clinical history of the case makes it evident that the morbid signs attributed to changes in the chest wall appeared suddenly, accompanied by subjective distress, nearly four weeks after the advent of the pneumothorax.

HABITUAL OR RECURRENT ANTERIOR DISLOCATION OF THE SHOULDER.

II. TREATMENT.

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Beyond the wearing of an apparatus, usually made of leather, I know of nothing, except operation, which may be expected to prevent recurrences of the dislocation. My patient wore an apparatus of this kind, and, while it seemed to aid in reducing the number of recurrences, the luxation did occur while he was wearing it. It did not permit him to abduct the arm to the horizontal position, and became burdensome. Schüller's patient experienced innumerable recurrences in spite of such a leather brace. Massage, electricity, and active and passive movements have been advised, but in view of the pathology of this condition, I cannot see how they could be expected to produce a cure.

OPERATIONS. Albert¹ prevented the recurrences in his case by an operation, which produced a bony ankylosis of the shoulder-joint (arthrodesis). It is hardly conceivable that any surgeon today would perform this operation. Cramer, Küster, Kraske, Popke, Volkmann (quoted by Popke, three cases), Schüller, Staffell² (two cases), W. Müller,³ and Francke have resected the head to prevent the recurrences. Perthes said that the operation of resection has been abandoned. Picque,⁴ however, in 1905, did this operation on one of his cases.

Capsulorrhaphy. Although the credit for the first capsulorrhaphy is generally given to Ricard, of France, who did the first of his two operations in 1892, Gerster,⁵ of New York, accomplished the same purpose by excising a piece of the capsule and suturing the edges of the opening together, in 1883, and Bardenheuer, in 1886, excised two pieces of the capsule. Good results were obtained in both cases. The two essential features of the operation are, the method of approaching the capsule and the method of shortening the relaxed portion, that is, removing the hernial pouch.

The shoulder is covered completely by the deltoid on the outer and posterior sides, and by the deltoid and pectoralis major on the anterior side. In most of the recorded cases the usual incision for a resection of the shoulder was employed. This passed from about

¹ Internat. klin. Rundschau, February 26, 1889, No. 9.

² Verhandl. d. Deut. Gesellsch. f. Chir., 1895, xxiv, 651.

³ Bull. et. mém. d. l. soc. d. chir. d. Par., N. S., xxxi.

⁴ Med. News, Phila., 1884, xlv, 423.

⁵ Ibid., xxvii, 154.

the coracoid process downward a variable distance toward the insertion of the deltoid, and either divided the anterior fibers of the deltoid or separated it from the pectoralis major. Burrell⁶ and Warren,⁷ in addition, divided the greater part of the insertion of the pectoralis major to allow its retraction inward. Ricard and Samter⁸ added to the vertical a horizontal incision extending outward from the upper end of the vertical incision along the origin of the deltoid muscle below the acromion and clavicle. Stinson made a similar horizontal incision outward from the middle of the vertical incision. Krumm, after making a vertical incision, turned the long head of the biceps out of its groove, replacing it later. Perthes varied the incision in each of his four cases. In the first he carried it from the coracoid process along the anterior margin of the deltoid nearly to its insertion, and then turned it upward along the posterior border of this muscle about half way. The skin and muscle flap was reflected upward without injury to the circumflex nerve. In his second case, he employed the posterior resection incision at the posterior border of the deltoid. An incision was then made along the spine of the scapula and acromion, and a 0.5. to 0.75 cm. strip of these bones chiselled off through a corresponding series of holes, which were made first. The flap was turned downward and forward. In his third case, he made an incision along the anterior margin of the deltoid, and then separated this muscle from the pectoralis major. Above the coracoid process the fibers of the deltoid were divided up to the clavicle. One centimeter from its end the coracoid process was first bored through for the later introduction of a wire suture. The coracoid was then sawed through and turned downward with the attached corabrachialis and short head of the biceps muscles. The pectoralis major was later divided for retraction inward. The object of this extensive incision was to expose the anterior margin of the glenoid cavity. In the fourth case, he employed the usual anterior resection incision, and in addition partially divided the deltoid at its origin from the clavicle. There is evidently a need of more uniformity in the method of approaching the capsule. While the anterior resection incision was generally used, as already stated, it was frequently found to give an insufficient exposure of the field of operation. Under any circumstances, such an incision is an extensive one. More attention should be paid to the underlying rotator muscles. Only one surgeon, Samter, it appears, divided the subscapularis muscle to obtain a freer exposure of the anterior dilated portion of the capsule. In my opinion, this is very desirable, and proved very serviceable in my own case. This muscle covers the whole anterior part of the capsule, with which it is intimately adherent, and can be drawn aside only with difficulty.

⁶ Trans. Amer. Surg. Assoc., 1897, 293.

⁷ Bost. Med. and Surg. Jour., March 12, 1903.

⁸ Verhandl. d. Deut. Gesellsch. f. Chir., 1900, xxix, 641.

I believe that the simplest, safest, and most effective operation can be done through an axillary incision. This conclusion was reached after a careful study of the dissected specimen, and seemed to be justified later by the operation. Kraske and Küster employed the axillary incision in resecting the head of the humerus for this condition. Burrell said that the operation was distinctly an anatomical one. This is true whatever method of approaching the joint is employed. A point which should be borne in mind is that the coracobrachialis and biceps pass downward over the subscapularis and front of the capsule close to the humeral attachment of the latter, so that a better exposure of the subscapu-

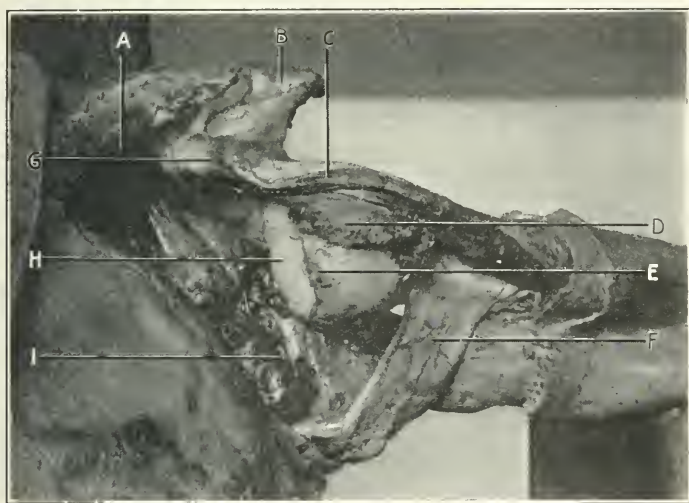


FIG. 1.—Experimental anterior dislocation of left shoulder, with the arm at right angles to the body. Anterior view. Deltoid and pectoralis major removed. A, clavicle; B, acromion process; C, coracobrachialis and biceps muscles; D, external portion of divided subscapularis muscle; E, edge of capsule torn from anterior and lower glenoid margin; F, latissimus dorsi muscle; I, inner portion of divided subscapularis; H, head of humerus; G, coracoid process.

laris, the underlying capsule, and the anterior glenoid margin can be obtained to the inner side of these muscles than to their outer side (Fig. 1). The usual resection incision through the anterior fibers of the deltoid will lie to their outer side, an axillary incision to their inner side. The head of the humerus is more superficial in the axilla than on any other side, and with abduction of the arm it is brought still nearer to the surface. The only muscle divided in my case was the subscapularis, and even this could be avoided by attacking the capsule below its lower border, as did Warren, although division of the muscle gives a much freer exposure and permits a more effective operation upon the capsule. It will be recalled that Perthes, in order to expose the anterior glenoid margin,

found it necessary to make an extensive and mutilating incision. The coracobrachialis forms an excellent guide for the axillary incision, so that the surgeon can easily pass inward between it and the axillary vessels and nerves without danger. There will be less danger to them than in the operation for ligating the axillary artery, since in the operation for the luxation we are not working on the vessels, but merely keeping them out of danger by a retractor. The musculocutaneous nerve which enters the coracobrachialis muscle at the lower part of the wound crosses the field of operation, and should be sought and retracted inward with the other nerves and the vessels. This exposes the subscapularis muscle, at the lower edge of which, between it and the upper border of the latissimus dorsi, the circumflex nerve and posterior circumflex vessels are easily located. The small anterior circumflex vessels must be divided between ligatures to permit retraction inward of the large vessels. A grooved director is then passed from below upward between the subscapularis and the capsule, and the muscle is divided. The cut ends of the subscapularis are then separated from the capsule and turned to their respective sides. In my case this gave a sufficient exposure of exactly the part of the capsule torn, now presenting a protrusion.

While excellent results have been obtained by reefing the capsule without opening it, exploration of the interior of the joint will be advisable, through an opening, to detect and remove any movable joint body and to repair any other lesion that may be present. This may be a tearing off of the long head of the biceps from its origin, which has been shown to have occurred, or a torn external rotator, which has been reported, but which I regard as not demonstrated. If necessary, an additional incision could easily be made over these structures through the deltoid under the guidance of the finger in the joint. This will rarely, if ever, be necessary. If one found, as I did, the margins of the original tear, they could be brought together by sutures (Figs. 2 and 3). If the relaxed capsule were thick and strong, with no recognizable signs of a tear, then it could be contracted by sutures and the opening in the capsule closed, or the same purpose could be accomplished by overlapping the edges of the opening in the capsule, as was done effectively by Mikulicz, or by excising a piece of the capsule. The exact method of shortening and strengthening the capsule does not seem to be a very important matter, judging from the good results obtained from the numerous methods employed by the various operators. According to Hildebrand, Genzmer injected iodoform into the affected joint, with a cure in two cases. Operation for the radical cure of inguinal hernia has, at least, not a better record. No deaths or ankyloses of the shoulder have been reported, so far as I could find, and only two recurrences. In one of these (Legueu⁹) the patient was an epileptic and had convulsions soon after the operation,

while the arm was still in the dressing. Eighty-five days, or twelve weeks, after the operation, in an epileptic attack he fell on the affected shoulder and thus experienced a new dislocation. Such a fall might readily produce a dislocation in a normal shoulder, and the case should not be considered one in which the operation failed

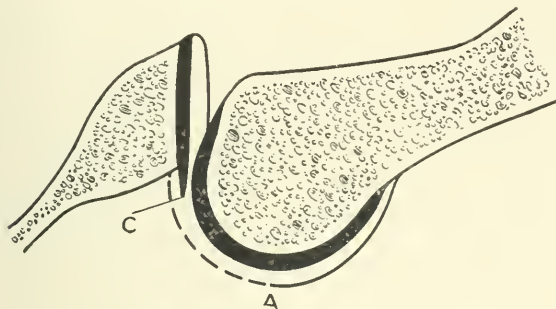


FIG. 2.—Tear in the capsule about one-half inch from the glenoid margin, found at operation in the case herewith reported. *A*, torn margin of the axillary portion of the capsule, still attached to the humerus; *C*, torn margin of the portion attached to the glenoid cavity.

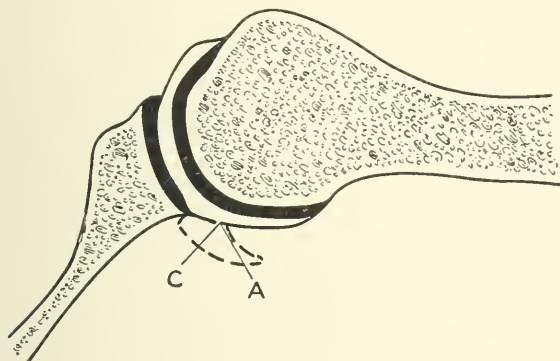


FIG. 3.—Repair of a rent found in the case herewith reported. The two torn margins of the capsule, *A* and *C*, were brought together by sutures. The new or cicatricial portion of the capsule was not removed, but was widely opened by the operative incision.

to cure. The other case, in which a recurrence followed the operation, was merely referred to by Hildebrand as having occurred in the practice of Haegler. I could not find a report of the case in the literature. Whenever the function of the shoulder, after the operation, was referred to it was always good, although it may not always have been perfect. Many of the cases were only briefly reported before societies, sometimes merely in the discussion of some paper, so that the detail necessary for a satisfactory study is lacking.

It is very probable that this operation has been unsuccessful in some cases that have not been published. We can determine its standing, however, only from the recorded cases, and upon that basis it has been eminently successful. The following is a brief summary of the functional results in the 34 capsulorrhaphy cases: In 27 the movements of the shoulder after operation were variously reported as perfectly normal, free, active without hindrance or with slight limitation of motion. In one of Burrel's two cases the operation had been done too recently to permit a report on the results. In Gerster's case the movements promised to become normal. Bardenheuer said of his case that it was successful, and that there had been no recurrence four months after operation. Wiesinger reported that the results were good in his case, and that in spite of severe epileptic attacks since the operation, there had been no recurrence. In Stimson's¹⁰ case there had been no recurrence six months after operation, and of Meyer's¹¹ case it was merely reported that there had been no recurrence up to the time of the report. As already stated, in Legueu's case there developed a recurrence twelve weeks after operation, from a cause sufficient to produce a luxation in a normal shoulder. Although before operation his patient had had a dislocation with nearly every epileptic attack, since the operation he had had several attacks, but only the one luxation.¹²

PERSONAL CASE. A young man, an athlete, aged twenty-three years, on November 26, 1904, while playing football, fell with both arms in abduction, and immediately experienced a severe pain in his right shoulder. Some companions at once pulled on the arm. A doctor, who was present, examined him soon afterward, and decided that there was no dislocation. Five days later, on Thanksgiving day, he played in another game, and again had a similar accident to the same shoulder, but he did not suffer as severely as in the first. Later, during the same evening, he fainted. During the following June, while wrestling in a gymnasium, he dislocated the same shoulder twice in the same evening, manipulations being necessary for the reduction both times. In September, 1906, he began to wear a leather shoulder brace, the chief object of which was to limit abduction. Previous to this time he had nine dislocations. Soon after beginning the use of the brace, and while it was in position, a dislocation occurred. This occurred on two other occasions, so that he had three dislocations while wearing the brace. He first consulted me soon after the brace was obtained, and again about a year later, or about a week after the last recurrence.

Examination at this time showed slight atrophy of the shoulder

¹⁰ *Annals of Surgery*, 1898, 364.

¹¹ *Ibid.*, xlvii, 811.

¹² The following are references to cases not already specifically alluded to: Dehner, *Munch. med. Woch.*, 1899, No. 5, 165; Grothe, *Ibid.*, 1900, No. 19, 650; Wolff, *Zentralbl. f. Chir.*, 1908, xlvii, 811; Albee, *Amer. Jour. Surg.*, 1908, xxii, 210.

muscles. He could not produce firm contraction of the biceps on the affected side, and the arm was $\frac{1}{4}$ inch less in circumference than the left. Movements of the shoulder were free in all directions except for the limited abduction due to fear of recurrence.

Operation, January 18, 1908, at St. Agnes' Hospital. The affected arm was placed at right angles with the body, and an incision about 6 inches long was made from the highest part of the axilla along the prominent coracobrachialis muscle, and underneath the pectoralis major. The capsule was exposed, as already described. Between the divided ends of the subscapularis muscle the capsule was very thin, and had been opened by the grooved director. The finger, introduced into the joint, detected nothing abnormal, except a considerable pouch under the coracoid process, continuous with the joint, and having a smooth inner surface. After turning aside the two portions of the divided muscle, it was seen that the capsule had been torn parallel with the glenoid margin, anteriorly and below. The outer torn edge was continuous with the thin new portion of capsule (Figs. 2 and 3), both being adherent to the under surface of the subscapularis, so that the line of union between the thin new and the normally thick old portion was located only after some search. The upper torn edge was seen attached to the glenoid margin, dividing the new space to its inner side from the normal joint to its outer side. It was somewhat shrivelled and shortened by angulation and adhesions. An effort was made to lengthen it by dissecting in one of its folds, with some success. The tear seemed to have extended from the long head of the biceps above to beyond the long head of the triceps below, but neither of these muscles was torn from its attachments. The margins of the capsule tear were then brought together by catgut sutures, the arm being brought toward the side of the body to slightly less than a right angle. The divided subscapularis was then sutured with catgut, and the skin with silkworm gut. No effort was made to close the pouch under the coracoid process, and now separated from the normal joint, except by the pressure of a good-sized gauze dressing in the axilla with the arm bound to the side of the body in a Velpau dressing. A week later, when the stitches were removed, there was considerable pain under the pectoralis major and below the coracoid process, and a slight rise in temperature. A collection being suspected in the extra-articular synovial pouch, a probe was passed through the newly healed wound and an escape of serous blood followed, which soon clotted. A small drainage tube was left in two days. There was no packing of the wound afterward, and no further trouble. (See Figs. 4 and 5.)

The patient left the hospital on the thirteenth day. All bandages were removed and a leather brace was substituted a week later. There was already considerable movement in the shoulder. In the fourth week he was permitted to use the arm as much as possible

without undue strain. In the sixth week the masseur was permitted to use forcible movements, and in two "treatments" he was able to place the arm in the vertical position in abduction with the arm alongside the head. The patient could hold it in this position by supporting it with the other hand.

October 14, 1908, nine months after operation, the patient had the full use of the affected arm and shoulder, in active, outside work as a surveyor. He began to work one month after the operation, and was soon able to swing the sledge for driving stakes and to do other such work. During the last summer he swam about 700 yards in a large lake without being accompanied by a boat. In boxing, he can deliver almost as hard a blow with the right arm as with the left. He can abduct the right arm as fully as the left, without associated movement of the scapula. (See Fig. 6.)



FIG. 4.—Showing atrophy of the biceps and deltoid of the right or affected side, six weeks after operation. The scar of the incision shows faintly.

CONCLUSIONS. Habitual or recurrent dislocation of the shoulder should receive more attention than has been given to it up to the present time, in view of the almost complete absence of statistics on the frequency of this condition, and the good results obtained from the operation of shortening the capsule.

The essential cause is a relaxation, due to the addition to the old, or original capsule, of a new cicatricial portion bridging over the gap between the margins of the tear in the anterior part, produced by the first dislocation. The numerous other causes which have been assigned to it probably have little or nothing to do with determining the recurrences, and require little or no attention at the time of operation, beyond the removal of loose fragments of bone. Although these have been discovered in relatively few cases, a more careful search for them may prove that they are more common than the literature now shows.

While recurrent dislocation of the shoulder has been known to undergo, apparently, spontaneous cure, this must be rare, and will always require many years. The result is even then very uncertain. Complicated shoulder braces may succeed in diminishing the number of recurrences, but only at the expense of much impairment of function and consequent atrophy of the muscles put out of action.



FIG. 5.—Illustrating a severe test of the ability of the repaired capsule to resist dislocation, six weeks after operation, *i. e.*, with the arm in marked abduction and the powerful adductor muscles of the shoulder in strong contraction.

The operation of shortening the capsule has been followed by success in 33 out of 34 cases collected from the literature, and in my own case. In only 1 did a recurrence take place, and in that case at the time of reporting the results the patient had had several epileptic attacks without another recurrence, although before the

operation he had been having them with every epileptic attack. His one recurrence took place in from three to four weeks after operation, and then from a degree of violence sufficient to have produced a dislocation in a normal shoulder. The condition is essentially a hernia of the joint, and the operation of capsulorrhaphy for the contraction of the capsule has given relatively as good, if not better, results than the Bassini operation for inguinal hernia.

Although, in all the 34 cases collected from the literature, the incision employed either divided the deltoid muscle or separated it from the pectoralis major, I believe that the axillary incision is

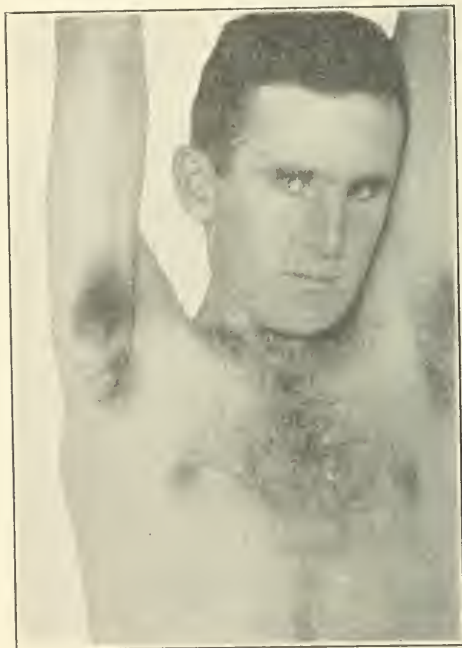


FIG. 6.—Arms in full abduction. The space between the head and the right arm is due to inclination of the head to the left side. Since this photograph was taken the scar has lost its rigidity.

better. By this route the deltoid is avoided, the site of the original anterior capsular tear and the resulting protrusion of the capsule are better exposed; the incision required is smaller, and if drainage should be necessary it would be dependent.

Judging from the results obtained by the various methods employed in the reported cases it would seem that an exact method of shortening the capsule is not important: although a folding of it by sutures without an opening in it, and therefore without intra-articular exploration, should be avoided, since a movable joint body, free or attached, may then be overlooked. The shortening may be provided by excision of a piece of the capsule and

uniting the margins of the opening by sutures, or by overlapping the borders of an incision made in the capsule. If the margins of the original tear are found, as in my case, they may be united by sutures.

I hope that this study of the subject will increase the confidence of the profession in shortening the capsule, as an operation quite sufficient for a radical cure, and that thereby many more sufferers from recurrent dislocations of the shoulder will find relief.

A RÖNTGENOGRAPHIC STUDY OF PERISTALSIS: THE RELATION OF WAVE FORM TO FUNCTIONAL ACTIVITY.

BY CHARLES LESTER LEONARD, A.M., M.D.,
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RECENT studies upon the living subject show that the normal stomach varies widely in shape and anatomical relations in different individuals. These normal variations differ entirely from the classical description of the anatomists. In fact, the physiological variations are so great that no type has been agreed upon as normal. The conclusion to be drawn is that the shape varies with the characteristics of the individual and that the stomach is normal which fulfils its functions perfectly.

The stomach is a freely movable, distensible organ, suspended at its cardiac and pyloric extremities. It varies in its size and shape with the amount of food ingested and the support given it by the other viscera under an intra-abdominal pressure exerted by the abdominal parieties. Its lower border and walls are freely distensible, while its lesser curvature is more rigid. It, however, changes its length and position in a remarkable manner even under normal conditions. It extends in length with an increased load, so that the pyloric end is often pushed far over to the right and curves back upon itself to the pylorus.

Deficient functional power may be present in stomachs that conform in shape to those having perfect function. Gastrectases, gastropnoes, and pyloroptoses have been described as pathological conditions. The significance of form can only be determined by estimating the functional efficiency in the individual case. This functional efficiency can only be determined by the ability of the stomach to empty itself in a given time.

Exclusive of newgrowths, ulcerations, scar-tissue contractions, and ptoses, gastrectases are the pathological conditions that most frequently interfere with functional efficiency. They may arise

from two diametrically opposed states. They are, on the one hand, the passive dilatation due to muscular atony and due to over-distention and lack of intra-abdominal support, and, on the other hand, dilatation with hypertrophy of the muscles caused by organic or spasmodic stricture of the pylorus. They are, therefore, sthenic and asthenic forms of gastrectasis, in which functional efficiency is defective, as shown by the residue of an ingested meal after the normal period in which the stomach should have emptied itself. The presence of this abnormal residue is determinable by employing the bismuth meal and the Röntgenographic method of examination. This, however, determines only a lack of motor efficiency, and does not differentiate between the sthenic and asthenic forms.

Is it possible for the Röntgen method to differentiate in any way between these two forms of motor insufficiency? The study of the stomach by the Röntgen method of examination has shown, in addition to the determination of motor insufficiency, variations in the size, shape, and position of the stomach. It has, in addition, determined the presence of newgrowths and scar-tissue contractions invading its lumen. The results of these studies upon the normal position and shape of the stomach and their pathological variations have been discussed at length by various authors, and will not be considered in this paper. This study is confined to variations in the form of peristaltic waves in their relation to normal and pathological conditions and their relation as a possible means of differentiating between the sthenic and asthenic types of gastrectasis.

Recent advances in apparatus and technique have made it possible to make instantaneous Röntgenograms of the stomach and intestines, which show some of the various forms of peristaltic waves under different normal and pathological conditions of the stomach. Although they are not as yet so extensive or complete as to justify absolute conclusions, certain deductions can be drawn with reference to the relation of peristaltic wave form to functional efficiency, which will aid in differentiating the sthenic from the asthenic pathological conditions of the stomach.

These studies show that there is a constant relation between the form and amplitude of the peristaltic wave and the amount of work to be accomplished, that the amplitude of the wave varies with the character of the food ingested, the position of the patient, and the amount of the gastric contents. They have shown that the amplitude varies in pathological conditions. The variations in sthenic and asthenic forms of gastrectasis are so distinct that apparently a differentiation can be made between gastrectasis due to a weakened musculature and that due to pyloric stenosis, whether organic or spasmodic. In the asthenic type the waves of peristalsis are practically absent when the patient is in an erect position and of but slight amplitude when the patient is prone or recumbent. In the sthenic

type the wave is of greater volume and less frequent, but particularly strong, when the patient is prone. The therapeutic value of rest after eating for all cases of motor insufficiency is thus demonstrated, since the waves are increased in strength.

The study of the peristaltic waves in the normal stomach under varying conditions in the kind and amount of food ingested shows that in the human subject the conditions are practically identical with those determined by Cannon in his classical studies on animals with the bismuth meal and fluoroscope. The difference between solids and liquids is seen not only in the stomach, but also in the œsophagus, boli of bismuth in bread and milk passing separately along the œsophagus, while bismuth in kumiss shows the entire shadow. The peristaltic waves vary in volume with the amount of food ingested, but are alike in type for the same kind of food, the shape of the waves differing when fluids or semisolids are employed.

When bismuth is taken in a glass of water the water is rapidly absorbed and the stomach is shown in its resting or nearly empty state, with a fine saw-tooth form of peristaltic wave. As the load increases, the amplitude of the wave increases, while its sinuous type persists. With semisolid contents, as bread and milk or rice pudding, the waves become less frequent with a greater amplitude, which shows that more work has to be done.

These characteristics are most prominent when the patient is prone, but retain their individuality of type when the erect position is assumed. In gastrectasis of the asthenic type all waves are practically absent when the patient is in the erect position. In the prone position they present the normal type, but are less frequent, while their decrease in amplitude shows the motor insufficiency. In gastrectasis due to obstruction the volume of the wave is more pronounced, though they are less frequent and are still more marked with the patient in the prone position, their increased amplitude showing that more work has to be accomplished.

The variations in the character of food ingested have not as yet been sufficiently great to determine the relative rapidity of their discharge from the stomach and passage through the intestines. They indicate, however, the possibility of further studies of great physiological interest.

One physiological fact, which had been suggested previously as possible, they have established, that is, that the stomach elongates to a marked extent during expiration. In one instance the difference in the perpendicular length of the stomach was one and one-half inches greater during expiration than in inspiration, while the base of the stomach remained at the same level. This motion may, in a measure, account for the ejaculatory expulsion of food from the pylorus which has been observed by some operators as distinct from the flow resulting from peristaltic action. Marked changes have

also been noted in the relation of the pyloric portion of the stomach to the pylorus itself, the stomach passing to the right beyond the pylorus and curving back upon itself.

The study of intestinal peristalsis has demonstrated differences in their character and in the shapes of their contents, but no segmentation, as described by Cannon in his observations on animals, has been shown. The peristaltic motion of the small intestine is so rapid that one-half second exposures are necessary to define sharply the fecal masses in the duodenum. Their shape differs entirely from that seen in the large intestine, indicating the presence of secondary waves of less volume. They apparently decrease in rapidity as the cecum is approached.

In the large intestine the subdivision of the intestinal contents is remarkable because of its completeness. This almost complete segmentation of the fecal masses, extending throughout the entire colon, indicates that the process of absorption continues throughout the entire colon. Various degrees of enteroptosis have been observed. That of the hepatic flexure is most common, and often includes the entire ascending colon, while ptoses of the splenic flexure and descending colon are rare. These ptoses seem to have little effect upon the motor efficiency of intestinal peristalsis, since the passage of the bismuth meal is apparently not delayed in cases in which they are present. They have, however, been found in cases suffering from intestinal indigestion, though their relation to this condition cannot be inferred, since they are found in other patients.

The plates to be shown illustrating these studies were made with an exposure of from one-half to one second. The meal employed was two ounces of bismuth, either subnitrate or carbonate, in water, kumiss, bread and milk, or rice pudding. Observations were made during the act of swallowing immediately after the ingestion of a part or the whole of the meal, and at intervals, one hour, six hours, and twenty-four hours after eating.

The accompanying plates illustrate the varying phases of peristaltic motion in some of the cases upon which this paper is based. Many of the patients presented marked gastric and intestinal symptoms, but those in which no motor insufficiency was present have been considered as normal in the type of peristalsis, since they did not differ from the normal cases studied.

The first illustrations show the difference between the passage of fluids and semisolids through the œsophagus.

Fig. 1 shows the entire œsophagus coated by two swallows of bismuth in kumiss. It was taken with the patient in the right oblique position, and shows the relation of the œsophagus in the mediastinum to the heart and spinal column.

Fig. 2 shows two boli of bread and milk with bismuth, passing down the œsophagus. The lower bolus is arrested at the dia-



FIG. 1



FIG. 2



FIG. 3



FIG. 4



FIG. 5



FIG. 6



FIG. 7



FIG. 8



FIG. 9



FIG. 10



FIG. 11



FIG. 12

phragmatic opening, in which a small portion is seen as a dark line projecting downward through the diaphragm.

Fig. 3 shows a normal stomach in a state of rest, the bismuth having been given in a glass of water. The stomach in this instance has the form of a distended intestine, with a very fine saw-tooth type of peristaltic wave, indicating that very little motor activity is demanded.

Fig. 4. The stomach is here partially filled with four ounces of a bismuth and kumiss meal. There is a distinct "Magenblase" filling the cardia. An undulatory peristaltic wave of small volume shows on the greater curvature of the stomach.

Fig. 5. This is the stomach of a man aged fifty years, with two ounces of bismuth subnitrate in a half pint of kumiss. The undulatory character of the peristaltic wave with fluid ingesta is striking. The fluid media with the bismuth can be seen rapidly passing through the pylorus, the ascending, the descending, and the re-ascending limbs of the duodenum. The exposure in this case was one second, and was not short enough to show the peristaltic waves of the duodenum.

Fig. 6. The bismuth meal consisted of bread and milk, and the stomach is partially filled with the patient in the erect position. The level of the fluid in the stomach is clearly defined, with the "Magenblase" or gas-filled cardia above, while below the level of the fluid is a second line which corresponds to the upper limit of the denser portion of the meal. Single undulatory waves of peristalsis of slight volume are seen along the greater curvature.

Fig. 7. In this patient the bismuth was given in eight ounces of rice pudding. The peristaltic waves are seen to differ from those of the fluid meal, and are typical of the more solid gastric contents. The wave is seen to be deeper and single, showing on both the lesser and the greater curvature. The longitudinal rugæ are distinctly seen filled with the bismuth meal where the stomach has widened in its upper portion after the passage of the peristaltic wave.

Fig. 8 shows the gastric residue and intestinal contents six hours after the bismuth meal in a case of defective motility of the asthenic type. The weak peristaltic wave is seen in the stomach, though the patient was in the prone position. The entire small intestine is shown filled with the bismuth meal.

Fig. 9 shows the large intestine of the same case as Fig. 7 six hours after the ingestion of the rice pudding and bismuth. The distinct segmentation of the feces is noted throughout the entire colon. There is a complete ptosis of the ascending colon and hepatic flexure, carrying with it the transverse colon. The splenic flexure is seen in its normal place with gaseous contents, while an accumulation of gas is also seen in the cecum. This plate was taken with the patient in an erect position. In another plate taken in the

prone position about the same time there is no alteration in the position of the intestine, but the gas is absent from the cecum.

Figs. 10, 11, and 12 are from the same patient, and are of particular interest, because they show motor insufficiency due to pyloric stenosis, the result of ulceration and spasm of the pylorus, which was demonstrated by a subsequent operation. In Fig. 10 there is a marked peristaltic wave in the lower third of the stomach nearing the pylorus. It involves both the lesser and greater curvatures, and corresponds to what has been described as the "sphincter antrum pylori." A second commencing wave is seen between the middle and upper thirds of the stomach, while the perpendicular rugæ of the cardia and left side of the stomach are shown by the bismuth remaining in them as the stomach expands laterally. It should be particularly noted that the lungs are filled with air, shortening the saggital length of the stomach, while its base is at the iliac crest or a little below it. When this plate is compared with Fig. 11 of the same stomach, taken immediately after the other, but with full expiration instead of full inspiration, the contrast in the length of the stomach is easily noted. The base remains at the same level, only it is narrower, while the peristaltic wave, called the "sphincter antrum pylori," has disappeared, and a second wave is shown in the middle third of the stomach. In addition, a very small notch, on the outer border of the stomach between the upper and middle thirds, indicates the commencement of another peristaltic wave.

Fig 12 shows the stomach and intestines of the same patient six hours after the bismuth meal. The residue of the bismuth meal is shown in the lower part of the stomach with marked peristaltic waves. Bismuth is seen in the pylorus and the descending and ascending links of the duodenum. The greater portion of the meal has, however, passed into the cecum and the ptosed ascending colon, but the transverse and descending portions of the colon are empty. This is in marked contrast to the condition of the colon in Fig. 9, where the meal has passed into the descending colon in the same length of time. In this plate the gas-filled portion of the colon can be seen, and also very distinctly the spleen and lower border of the liver. The presence of this residue in the stomach shows motor insufficiency, but the character and strength of the peristaltic wave indicates no lack of muscular power, so that some form of obstruction was diagnosed. The subsequent operation disclosed an ulcer near the pylorus with a spasmodic stricture.

INTESTINAL SAND: THE BANANA ONE OF ITS SOURCES.BY **JESSE S. MYER, M.D.,**LECTURER IN MEDICINE IN THE MEDICAL DEPARTMENT OF THE WASHINGTON UNIVERSITY,
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A CAREFUL perusal of the literature on intestinal sand brings one to a realization of the chaotic state of the entire subject at the present time: the symptomatology, the nomenclature, and the descriptions of intestinal sand are at present at great variance. Our attention was first directed especially to the subject by a case which we believed to be one of "true intestinal sand." Upon further study, however, we ascertained the real but extraneous origin of the sand, and at the same time we were led to the conclusion that the substance described in many of the cases owes its origin to the same or a similar source as that of our own. Contrary to the teaching of the French school especially, we do not consider intestinal sand a clinical entity nor productive of a definite train of symptoms. In arriving at these conclusions, we have endeavored to present as complete a bibliography as possible, and although some of the articles quoted may seem irrelevant, they have become so intimately interwoven with the literature in general that we deem it wise to record them here.

The sand in our case was of definite character, a finely divided material, and was passed by a young woman, aged twenty-four years, complaining of a feeling of intense fulness in the abdomen and chronic constipation. There was no gout or rheumatism in the family. The abdomen was tense and slightly tympanitic; there was a movable right kidney of the second degree; the stomach was in moderate ptosis, but otherwise negative. The feces were dark brown in color, firm in consistency, and contained a little mucus and fine granules resembling sand. One to one and one-half grams of this sand was washed from the feces daily. This sand was found in the motions for two weeks and then gradually disappeared. A nearer description of the substance will be given later.

We were at a loss to explain the phenomenon or to know in what relation the presence of the sand stood to the symptoms of which the patient complained. Nor did reference to the various textbooks at hand tend much to enlighten us.

Emerson writes:¹ "True intestinal sand, of which we have seen but one good case, seems to be the result of a secretory neurosis of the intestine. It occurs in neurasthenic persons, and often in association with membranous colitis. Such stools are often pre-

¹ *Clinical Diagnosis*, 1906, p. 371.

ceded by about an hour of severe pain.” Cohnheim² and Thompson³ state that the term intestinal sand or sable intestinal is applied to the passage in the stool of sand-like particles of varied composition, usually composed of masses of vegetable material, such as the granules from the pear, the seeds of raspberries, blackberries, etc. Osler⁴ writes similarly, and adds: “I have recently seen a case in which the patient on two occasions passed a considerable quantity of sand. The sample which he brought consisted of small grains, some of a beautiful garnet color. They proved to be vegetable matter.” Anders⁵ and Sahli⁶ speak in this connection of hepatic calculi which have passed into the intestine, or earthy concretions or incrustations of food rests with earthy salts. Schmidt and Strasburger:⁷ “The small concretions, which by the French authors go under the name of intestinal lithiasis, are often associated with membranous enteritis.” Nothnagel⁸ differentiates between the true and the false extraneous intestinal sand. He says that true intestinal lithiasis is nearly always associated with mucous colic. It has been regarded as due to a lithogenic catarrh of the bowel, and might be compared with the process which gives rise to the formation of concretions in the vermiform appendix. False intestinal sand may be of various kinds, but is usually the remains of indigestible vegetable food, which may or may not become encrusted with earthy salts.

The vague and meagre text-book references are out of proportion to the voluminous clinical reports on the subject, in which all manner of symptoms are cited and attributed to the presence of the sand. We shall cite here briefly a few of these reports in order to show that the present acceptance of the subject is based largely upon a popular fallacy which has been handed down from one author to another.

To Laboulbène⁹ is justly given the credit of reporting the first cases of intestinal sand in 1873, under the title, “Les sable intestinaux.” He reported cases in which he found a sandy substance (sable intestinal) resembling very much brown or yellow sand, which he believed to be of vegetable origin.

The next article to which we find reference is that of Biaggi.¹⁰ Strictly speaking, this case bears no relation to that described by us, and we should not consider it worthy of mention in this connection were it not for the fact that the author considered the calculi a manifestation of a true diathesis, which hypothesis seems to have formed

² Die Krankheiten des Verdauungskanaals, Berlin, 1905, p. 169.

³ Text-book of Practical Medicine, 1902, p. 431.

⁴ Practice of Medicine.

⁶ Klin. Untersuchungsmethoden, 1905, p. 455.

⁷ Faeces des Menschen, 1903, p. 227.

⁸ Encyclopedia of Practical Medicine, Intestines and Peritoneum, Amer. Edition, 1904, pp. 94 to 96.

⁹ Bull. de l'acad. de méd., November, 1873.

¹⁰ Presse méd. Belge, v. 26 (20), 19 avril, pp. 153 to 154.

⁵ Ibid., 1905.

the foundation for subsequent articles of French authors, in which this belief is prevalent. Marquez,¹¹ in 1879, reported a case of a woman with herpes, an arthritic disturbance, chronic catarrh of the large intestine, more or less pain, especial intolerance for vegetables and fruits, etc. In this case sand was discovered in the feces, which had the aspect of corpuscles, mostly granular, brown or some white. The sand was of irregular form, and some grains bristled with small crystals. Into their composition entered nitrogenous matter and to a marked degree mineral matter, containing 72 per cent. of organic matter and 28 per cent. of inorganic matter, mostly the carbonate and phosphate of calcium. The subject seems to have received no further consideration in the literature until 1895, when Monjour¹² describes the case of a young woman, "arthritic and neuropathic," with a mucomembranous colitis, obstinate constipation, and the presence in her stools of small gravel.

Fontey¹³ presented a Bordeaux Thesis upon this subject. He states that under pathological conditions the intestinal mucosa may give rise to sand, and quotes the articles of Schoenlein¹⁴ and Bellingham¹⁵ in proof thereof. The former, in an epidemic of typhoid fever in 1835, found in the stools microscopic crystals of calcium phosphate and sulphate and a sodium salt, which he thought were constantly present in typhoid fever and of decided diagnostic value. The latter's case was one of bronchopneumonia, in which the postmortem examination showed great numbers of ammonium magnesium phosphate crystals in the colon. Oddo,¹⁶ in 1896, reported the case of a woman, aged fifty years, with rheumatism, frequent attacks of urticaria, arrhythmic pulse, emotional spells of fainting, and painful intestinal crises. The stools were found to contain bodies of irregular shape, varying in size from a grain of sand to a small lentil. Mathieu and Richard¹⁷ reported two cases in which the patient passed quantities of fine sand, of a dirty yellow or chestnut-brown color, in diameter from 0.25 to 1.5 mm. The authors express surprise at the frequency with which mucous enteritis existed in cases of intestinal sand which have come under their notice. Shattock,¹⁸ in 1897, gives an excellent description of a case of intestinal sand under the title of "sable intestinal." The material consisted of small spheroidal grains of a pale brown color, which he thought were composed of compact groups of thickened vegetable cells, having the character of sclerenchyma extremely thickened by a succession of secondary deposits. The patient

¹¹ Assoc. Française pour l'avancement des sciences, 1879, p. 878.

¹² Compt. rend. de. la soc. biol., series I, 1896, t. iii, 203.

¹³ Thèse de Bordeaux, 1896.

¹⁴ Arch. f. Anat., Phys. u. wissensch. Med., Berlin, 1836, pp. 258 to 261.

¹⁵ Dublin Jour. Med. Sci., 1838, xiv, 278.

¹⁶ Bull. et mém. de la soc. méd. des hôp., June 25, 1896.

¹⁷ Trans. Path. Soc., London, xlviii, 124.

¹⁸ Ibid., 473.

had suffered from hydronephrosis, and these cells were first mistaken for urinary calculi.

Dieulafoy¹⁹ has presented one of the most exhaustive treatises on the subject, in which he recites a large number of cases. He lays the greatest stress upon the frequency of mucomembranous colitis, and believes intestinal sand to be a manifestation of a lithogenic diathesis, and therefore comparable with the kidney stone and tophus. The following is an abstract of one of his cases: A man, aged forty-eight years, gouty father. He himself gouty. Headaches, hemorrhoids, eczema, asthma, renal colic, with phosphatic calculi. Several years later a new phase developed. In the evenings the patient had pain in the right hypochondrium, spreading to the epigastrium and thorax. In his stools he found intestinal sand and mucus. It is important to note that on the day the intestinal sand made its appearance the pain about the kidney ceased completely. The author considers that these observations show the relation that exists between intestinal lithiasis and gouty diathesis, though he does not maintain that all cases are of a gouty nature. One can see that renal and biliary lithiasis are seen in the same individual at different times of life, or exist in the family as an hereditary manifestation.

Eichhorst²⁰ takes exception to the fact that the term "sand" is used indiscriminately for fine sand-like bodies, as well as for the large concretions. He thinks that intestinal sand is not a frequent occurrence, having seen only two cases in seventeen years. His first was in a woman, aged thirty-five years, who complained of obstinate constipation, which had not yielded to treatment. The grains were in every way like a sand when shaken up in a test-tube or placed under the microscope. In water the granules remained unchanged after days; also in alcohol and ether. The grains contained earthy carbonate salts, which upon the addition of mineral acids were seen to generate gas. As to the organic portion, two kinds were differentiated: one was composed of thread-like masses, which were held together by a transparent mass, the other was in all probability crystals of fatty acid. The next year Deetz²¹ reported a case in a man, aged fifty years, who had symptoms characteristic of renal colic, and noticed sand-like bodies in his stool. The sand was hard, finely granular, and had a light or dark brown color. Saint-Phillippe²² in discussing the occurrence of crises of abdominal pain in children associated with constipation, states that in 50 such cases he has also found an intestinal lithiasis.

In the English literature, the authors have, as a rule, described fine sand-like substances, and not gravel or larger concretions. Bedford²³ gives the following description: "The sand was a very fine, granular, yellowish brown substance, very like fine sand, of which not

¹⁹ Bull. de l'acad. de m  d., Paris, 1897.

²⁰ Deut. Archiv f. klin. Med., lxxviii, Heft 1 and 2.

²² Jour. de m  d. de Bordeaux, 1901, No. 49.

²¹ Ibid., 1901, lxx, 365.

²³ Lancet, 1902, ii, 215.

more than one-half teaspoonful was passed at a time. Under the microscope the particles were of various shapes and sizes, oblong, oval, or irregular. The color varied from black, through reddish brown, to light yellow. Many of the granules were translucent only at the edges, and had no appearance of vegetable or crystalline structure. The organic portion amounted to 60 per cent." The same year Duckworth and Garrod²⁴ reported a case in a woman, aged thirty-three years, who had an attack of persistent diarrhœa lasting for three or four months. The stools contained oblong, rod-shaped, or irregular granules, 0.05 to 0.2 mm. long, varying in color from yellow to brown, some translucent, others opaque, except at the edges. The organic portion amounted to 40 per cent. Mitchell²⁵ reports a case of a man, aged forty-two years, who passed a pale brownish sand while on an exclusive milk diet. Ferguson and Thompson²⁶ have reported the case of a lady, aged thirty years, with moderate dilatation of the stomach, and at times decided neuroses approaching hysteria. In one of her periodical gastric attacks, she was given milk and lime water, and during this time a considerable amount of sandy matter was discovered in the motions. The sand was passed regularly for several months. It sank rapidly in water, presented a brownish yellow appearance, strongly suggestive of uric acid, and when examined microscopically the resemblance was striking. However, the murexide test was negative. Tierlinck²⁷ recently reported a case occurring in a woman, aged thirty-eight years, who had very painful abdominal crises, localized along the colon. The stools revealed the macroscopic presence of intestinal concretions of greater or less amount with much mucus.

When we survey the various descriptions of the intestinal sand in the articles we have just reviewed, it seems that we may separate them roughly into three classes: (1) Those in which the material really resembled fine sand-like granules, ranging in size from 0.15 mm. up to 1 or even 2 mm.; (2) those in which the word gravel or calculus more nearly suits the description than the word sand, the objects varying from the size of a lentil to that of a pigeon's egg or larger; and (3) those in which the description of the material itself is so indefinite that we can only infer that in using the term intestinal sand, the author had before him some sort of intestinal concretion resembling those of either class 1 or 2. We shall, therefore, confine ourselves to a consideration of these first two classes. When we examine those cases in which the "sand" is large as orange seeds, the question at once arises, Are these not ordinary fecal concretions? Biaggi describes balls 6 to 8 cm. in circumference, composed of ammonium magnesium phosphate, plant hairs, cells, etc. Oddo describes bodies varying in size from a grain of sand to a lentil,

²⁴ *Lancet*, March 8, 1902; *Medico-Chir. Trans.* 1901, lxxxiv, 389.

²⁵ *Trans. Coll. Phys. Phila.*, 1903, xxv.

²⁶ *Jour. Path. and Bact.*, 1900, vi, 334.

²⁷ *Bull. soc. de méd. de Gand.*, 1907, lxxiv, 96, 97.

with 28 per cent. fatty material. Most certainly this seems to be nothing else but inspissated fecal matter. In fact, Dieulafoy, in one of his cases, gives the following analysis of the concretions: Water, 11.25; fecal matter, 22.60; phosphoric acid, 17.56; calcium 26.22; magnesium, 14.05; silica, 5.68. It is true that this shows a somewhat greater proportion of inorganic salts than we would expect in ordinary fecal material, unless the patient had taken considerable milk.

When we turn to look at those cases coming under the first class, small sand-like grains, we are confronted with a puzzling variety of materials of various description: grains 0.2 to 1 mm., with irregular crystalline projections, accompanied by unaltered vegetable cells thickened by secondary deposit, which measured from 0.5 to 1 mm., and had been diagnosticated as renal calculi (Shattock). In the first case of Eichhorst the sand was "like urinary sediment." Duckworth and Garrod describe grains 0.05 to 0.2 mm., containing 60 per cent. ash, some of which was carbonate. These authors also distinguish between "false" and "true" sand, that which contains a nucleus of vegetable cells, or fruit seeds, such as Delepine and Verco have described, and that which (supposedly) has no such origin and is mostly composed of inorganic salts. Bedford also makes the distinction between "true" and "false" sand, and says that true sand contains a much higher percentage (28 to 70 per cent.) of inorganic salts than the false variety, except "in the case of the calculi produced in the intestines of people fed upon bread made from oat bran, which often contains from 60 to 70 per cent. inorganic matter." It seems more reasonable to believe that when the sand contains a large amount of mineral salts the cell or cells which had formed the nucleus are overlooked, and the sand is "true" sand; when the deposit has not been so great, the vegetable structures may be seen, and it is then considered "false" sand. Granted, perhaps, that there were such a thing as true sand, formed by an excretory process of the intestinal mucosa, we would still be at a loss to explain the 30 to 70 per cent. of organic matter which this true variety contains, for the ordinary organic constituents of the body, calculi, urea, cholesterin, uric acid, etc., are all absent. Delepine,²⁸ who has described specimens of "sable intestinal" which were formed by cells from the pear and various seeds coated with salts, calcium carbonate, phosphates, and oxalates, says, "It is only when these seeds are retained some time in the bowel and have time to become covered with calcareous matter that their presence is of interest to pathology." This statement becomes more significant when we notice that in the cases of Mathieu and Richard, Eichhorst, Ferguson, and Bedford, who give a high inorganic content for the sand, the patients suffered from "habitual constipation." Verco²⁹ found

²⁸ Trans. Path. Soc. London, 1890, xli, 111.

²⁹ Australasian Med. Gaz., Sydney, 1904, xxiii, p. 300.

in the stools of one of his patients small sand-like particles which he found later were the cells of the pear with calcareous coating, which consisted of carbonates and phosphates.

As to the various clinical manifestations which have been mentioned in relation to intestinal sand, we believe them to be largely unrelated and accidental, except as to the role constipation may play. However, it does not seem at all strange that gastro-intestinal symptoms have been encountered in practically every case reported. Physicians in general do not make a habit of examining the feces of every patient irrespective of intestinal symptoms, and it is only when such symptoms exist that they feel it necessary to note the character of the stool. The immense number of times that intestinal sand is present without some concomitant gastro-intestinal trouble is not taken into account. As to the importance of mucous colitis as an etiological factor, since this is the disease par excellence in which an examination of the stool is always made, in which the diagnosis is directly dependent upon such an examination, we need not be surprised that intestinal sand has been found in some of these cases. That it is not present in a majority, or even in many cases, does not need to be proved. We shall not deal with the great variety of other factors which have been brought forward as having an etiological bearing upon the subject. However, to show to what extreme this speculation has gone, we might cite the remarks of McNamara³⁰ and Renshaw,³¹ who suggest that the excretion of sand is a reversion in the mammal to the egg-shell-forming function of the bird, and Bernhang,³² who thinks that just as discharges of meconium in certain presentation of the foetus subpartu is to be viewed as a *signum mali omnis*, so would he consider discharges of intestinal sand as a sign of the patient's being in greatest danger of life.

We wish now to go somewhat more definitely into a description of the sand in our case, its origin, and possible relation to the cases already cited: Upon macroscopical examination the stool was seen to be full of small black or brown sand-like granules, intimately admixed. The stool was washed through a fine sieve, and both the wash water and the residue were carefully examined. The greater amount of sand was to be found in the wash water, a dram or two being obtained from each washing. It has a brownish, sandy appearance, and feels gritty when taken between the fingers. Under the microscope the sand is seen to consist of irregularly shaped grains, varying in size from 0.05 to 0.2 mm., approximating more or less the oval form (Fig. 1.) They are translucent, but not transparent, and vary in color from a light yellow to dark yellow, brownish and greenish yellow, and many of them are of the color of uric acid crystals or garnets. When viewed by reflected light, the grains have a beautiful appearance, resembling a collection

³⁰ Brit. Med. Jour., 1903, i, 311.

³² Deut. klin.-therap. Woch., 1906, iii, 425

³¹ Ibid., p. 666.

of varied colored quartz. The grains are hard and brittle and are crushed with great difficulty under the cover glass. In one specimen which we obtained, concentrated acid caused the evolution of gas, and the sand became a much lighter yellow. Boiling water, alcohol, ether, chloroform, and dilute acids had apparently no effect upon the granules. The murexide and sodium hypobromite tests were negative.

We are indebted to Dr. Wm. H. Warren, of Washington University, for the examination of a single specimen of sand, in which he found 17.2 per cent. of moisture, after the extraction of which there remained 95.8 per cent. of organic matter. The nitrogen determination (Kjeldahl) yielded 2.5 per cent. The inorganic portion was found to consist mainly of phosphate of calcium.



FIG. 1.—Intestinal sand obtained from the feces twenty-four to forty-eight hours after the ingestion of a banana.

We had arrived at the conclusion in our own minds that this sand was of vegetable origin, because of the high organic content, the regularity of shape and size of the grains, etc., but were laboring under the false impression that they were cellulose remnants, which through a prolonged sojourn in the intestine became permeated with certain insoluble salts, whose origin we were unable to explain. We felt the more certain of this upon finding in a single specimen of feces from a child several chains of sand, identical in appearance with the grains found in our first case. We endeavored, through the ingestion of various vegetables, to produce sand artificially, but were not able to do so. While making a routine examination of a specimen of feces, our colleague, Dr. Wm. Rush, called our attention to a chain of sand, together with two or three fibrovascular bundles having their origin from a common point and separated by a mass of parenchyma cells. It was suggested by him from its histological structure that this might be a remnant of the tissue of banana, and this it proved to be. Following this suggestion, we

were able to produce, *ad libitum*, sand identical with that found in our original case and apparently identical with that described by various authors, and to which a long train of symptoms were attributed. Through eating one or two bananas and examining the feces twenty-four hours later, intestinal sand may be found in teaspoonful to tablespoonful quantities, and may be found for several days afterward, diminishing gradually. In case of constipation, it may be found for a much longer period. The grains are found singly, as a rule, but also in chains if the stool is not manipulated too much in the process of washing. The discovery of the banana as a cause of intestinal sand enabled us to examine the literature from another standpoint, whereupon we met with the following references: Bates,³³ in 1887, published a paper entitled "Intestinal Concretions Resembling Sand and Originating in Cells from the Banana," in which he described these same small, organic, sand-like cells which he had washed from the stools of a child suffering from habitual constipation and attacks of gastric colic. He

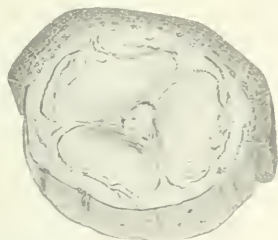


FIG. 2.—Transverse section through the ripe banana treated with a 10 per cent. aqueous solution of ferric chloride, showing the pansy-like arrangement of the milk tubes.

had shown these cells to a great number of physicians, without being enlightened as to their origin, when Edes³⁴ recognized them as of the same origin as those he had described. Edes was also led to the proper interpretation of the banana as the origin of the sand, by the fact that some of the undigested banana tissue accompanied the sand-like cells.

If the banana is sectioned transversely and exposed to the air for a time, light brown markings appear on its surface, radiating from the centre toward the periphery, where they turn to form an arch with an adjacent line. If certain substances are poured upon its surface, such as ferric chloride, which acts very rapidly and decidedly, these markings are beautifully brought forth (Fig. 2). They stand out as black chains or strands embedded in the tissue of the banana. Under the microscope these are found to be identical with the grains and chains of sand found in the feces of those ingesting bananas, but are not so hard. If one obtains a thin section of the banana, or

³³ AMER. JOUR. MED. SCI., 1887.

³⁴ Boston Med. and Surg. Jour., May 10, 1883.

strips off one of the long longitudinal strands from the inner side of the peeling, and treats this with ferric chloride, the chains are found to be made up of small masses of a garnet-colored substance, each contained within a cell membrane. The garnet-colored bodies are evidently the contents of the cells (Fig. 3). If examined in a fresh state, unaffected by chemical agents, these cells are found to be chains or threads of homogeneous bodies united end to end, soft enough to be influenced by pressure upon the cover glass, which causes them to burst and exude a gelatinous, colorless mass. The chains run in pairs, surrounding the fibrovascular bundles. In the botanical literature, put at our disposal by Professor W. Trelease, of the Missouri Botanical Garden, were found but few references bearing directly upon the subject. In Engler and Prantl³⁵



FIG. 3. —A small portion of a banana treated with a 10 per cent. aqueous solution of ferric chloride (magnified 70 diameters), showing double chains of milk-tube cells accompanying the fibrovascular bundles, with parenchyma cells intervening.

reference is found to the milk tubes in the *Musa*, which consist of cylindrical rows, one above the other, of cells rich in tannin. De Bary³⁶ refers to jointed milk tubes (*gegliederte Milchröhren*) produced by end to end fusion of cells, and says: "In the stem, as well as in the fruit, the vascular bundles are accompanied by milk tubes two to six in number, symmetrically arranged and separated from them by one or two layers of parenchyma cells. . . . These milk tubes consist of a row of vertical cylindrical cells, one above the other, four times as long as they are wide, and through a round wide opening at each end are converted into a continuous tube. They contain large homogeneous, highly refractive resin balls or masses, suspended in a fluid very rich in tannin."

These resin balls, then, the contents of the cells, suspended in a fluid rich in tannin, are affected by the secretions of the stomach

³⁵ *Die Natürlichen Pflanzenfamilien*, 1889, ii, 6.

³⁶ *Vergleichende Anatomie bei Phanerogamen und Farne*, 1877, pp. 153, 160, 451.

and intestine in a manner similar to the action of the ferric chloride, hardening the resin and producing an insoluble tannate. The cell wall is digested or destroyed, and the hard resin-tannin-containing mass is liberated as a grain of sand. The extreme hardness of the grains found in the feces is due evidently to the prolonged influence of the secretions and salts in the intestinal canal, and the color to a tannate formed, influenced perhaps to some extent by other coloring matters in the intestines. We were unable to give the same hardness to the sand produced artificially outside of the body through treating it with hydrochloric acid and pepsin, saliva, pancreatin, ferric chloride, or by mixing it with the feces, etc., though nearly all of these agents hardened the grains to a certain degree and gave to them the typical color. Thus far, we have been unable to find other fruits or vegetables which give rise to similar bodies.

That intestinal sand may be produced through the ingestion of the banana has been proved by us beyond a doubt; that the descriptions of the sand reported in the literature by some authors seem identical with ours is certain; that many of these were due to the ingestion of the banana, or some other fruit or vegetable having like structure, seems most probable.

GENERAL AND SPECIFIC RESISTANCE TO TUBERCULOUS INFECTION.

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BEFORE discussing general and specific resistance to tuberculous infection, I wish to refer briefly to infection in general. Omitting much that would perhaps be relevant to a fuller elucidation of the subject, I may state the accepted fact that a bacterial invasion of a living organism can occur only when the related bacteria find conditions favorable to their life and multiplication within its tissues, and that the action of their toxic products depends upon a receptivity for them by the component tissue cells. The primary effect and the course of such an infection may be influenced or modified by the bacteria themselves: first by the number of living units which have gained entrance, and, second, by their life energy and their adaptation or virulence for the particular species of animal. The character and function of the tissue in which the growth and multiplication of the bacteria takes place, and in any case their biochemical properties have a determining influence.

When an infection has actually occurred, one of three things can happen: (1) The bacteria may be destroyed; (2) they may

continue alive, but are prevented from growing and multiplying; and (3) they may grow and multiply and in due course of time produce their characteristic effects. In such a case a small number of living bacteria would be of but temporary influence, the evolution of the disease could for a time be slower, but so long as growth and multiplication is possible, the disadvantage of a small number would in time be overcome when new generations have formed, and these would likewise be free from the effect of a check in vitality which might have occurred to the bacteria which were primarily concerned in the infection.

Virulence is so closely associated with growth and multiplication and the latter with the nutritive soil, that many observers consider growth-energy and virulence to be identical. That the composition of the soil is of importance is well known from experience in the artificial cultivation of pathogenic bacteria, although this permits of a materially greater variation than is likely to be present in the tissues of the same species. When we nevertheless observe it in the latter, it is because we deal with a living soil, which is subject to influences of a biochemical nature; and in addition to *substance*, we are obliged to take into consideration *vital functions* of a very complex nature. These functions are of cellular origin and can be general or special; in their general aspect they are intimately related to cell nutrition, and in their totality and integrity they constitute the normal manifestations of life.

Some of them are regulative and thereby protective in maintaining a properly adjusted balance. Minor disturbances, and especially such as are frequently repeated, are adjusted automatically and rapidly enough for the individual to remain unconscious of their occurrence. Others, of a severer degree, and especially such as are unusual or entirely new, manifest themselves in what we call disease, and then the restoration of the balance may occur more slowly or it may fail. This depends upon the nature and degree as well as upon the duration of the disturbing factors, and in infectious diseases latent cell functions may become active, or apparently new functions may develop to aid in the restoration of a normal equilibrium.

These general principles apply to all disturbances of normal life conditions, and those which are produced by pathogenic bacteria conform to the same general laws. The fact that our understanding of these laws is often only fragmentary and, therefore, greatly limited, does not justify their denial, even though we see apparent contradictions. Many such have in the past confronted human inquiry on other subjects, and often in simpler propositions than in those pertaining to the study of the phenomena of health and of disease; and some of them have finally found their elucidation upon these same primitive principles. All such studies required in the first place the formulating of theories, and for the origin of tuberculosis the theory of its direct inheritance or of a

special inherited predisposition is but natural for the time in which it was evolved. When theories, however, do not find support in observed facts, or when new facts are discovered with which they cannot be brought into harmony, then they require reconsideration, which may necessitate modifications or their entire abandonment.

Such reconsiderations have engaged the attention of many able students of tuberculosis, especially since the actual demonstration of the strictly infectious nature of the disease as a new fact, and the study of immunity since then has added other facts which I believe to be out of harmony with some of our former views and with accurate clinical observations.

The latter have shown that good preëxisting health and a perfect family history by no means protect against the acquirement of tuberculosis or even modify its course favorably, and the evidence is growing stronger that impairment of health before the outbreak of the disease depends frequently upon a tuberculous infection which, by its hidden localization or by its earlier insidious progress, was overlooked.

The enormous tuberculosis mortality among primitive peoples, when once they are exposed to infection, in whom we see likewise the least resistance in its course, is also significant and supports the view that individuals and races are primarily non-resistant and that subsequent generations develop previously latent or new protective functions which become efficient in proportion to the frequency with which they have been exercised in the ascendants. For the lack of resistance in such primitive peoples to tuberculosis I need but cite the observations collected by Hirsch¹ in regard to negro and other races in their native countries, and those which have been made on the negro and Indian population in the United States.² The interested student will find additional data in the publication by Reibmayr,³ not only for comparison of prevalence and mortality in aboriginal races before and after the advent of tuberculosis among them, but also evidence that the frequency and fatality of the disease decreases in civilized races, accordingly as they have had to contend with the disease for longer or shorter periods of time. Reibmayr's data are supported by similar studies by Marengos,⁴ Fishberg,⁵ and others upon the Jewish race; and although the presumed resistance of the latter is no doubt often overestimated and may be variously modified and lowered, the correctness of the claim of their greater resistance, becomes apparent when their mortality and morbidity from tuberculosis is compared with that of peoples who have more recently come under the influence of the disease and who are otherwise living under similar or even better conditions.

¹ Historisch-Geographische Pathologie, Stuttgart, 1886, iii, 156.

² Martin, Trans. Nat. Tub. Assoc., Washington, 1906, p. 91; Jones, *Ibid.*, p. 97; Harris, Jour. Amer. Med. Assoc., 1903, xli, 834; Adams, Medical Record, 1907, xxxiii, 833.

³ Die Ehe Tuberkulöser und ihre Folgen, 1894, 35.

⁴ Grèce médicale, October, 1901.

⁵ Amer. Med., 1901, ii, 695.

A recent study by Woods Hutchinson⁶ shows, among certain tribes of American Indians, a tuberculosis mortality of from two-thirds to three-fourths of all deaths, and this author, like Effertz⁷ and many others, calls attention to the rapidly fatal course of the disease among the Indians from which previous robust health and physical vigor was unable to protect.

The observations of Johnston⁸ of a difference in morbidity of 60 to 65 per cent. as between European and native troops in the British army in India, and the records of 290 deaths from tuberculosis per 1000 hospital admissions in the Egyptian army recruited from natives, as shown by Captain Cummins⁹ cannot be well explained upon any other theory than that Europeans are possessed of a certain degree of racial resistance. On the other hand we have all observed more or less numerous instances of long continued exposure with apparent escape from infection or of a favorable, or an extremely chronic course of the disease, in individuals whose physical and general condition was anything but indicative of a strong constitution or vigorous health; and in studies of the influence upon prognosis of a tuberculous family history nothing has been shown to indicate that it interferes with the prospect for arrestment of the disease or with recovery.

The freedom from tuberculosis of races and peoples that had as yet not been brought in contact with the disease was at one time considered an evidence of their immunity, but the error of this view has become apparent enough; and instead, it has been found that their effective exposure is followed by infection with almost mathematical certainty, and when this occurs through contact with tuberculous individuals whose disease follows an essentially chronic or favorable course, they, themselves, develop a most virulent and fatal type, showing that the virulence is conditioned by the new soil and not by its variation in the bacillus. Maffucci¹⁰ has been able to demonstrate the difference experimentally in chicks. When they had a tuberculous parentage, their infection was followed by a chronic form of tuberculosis with a tendency to recovery, whereas in those of healthy parentage, the course of the infection was acute and rapidly fatal.

The comparatively lower mortality from tuberculosis in peoples who have long battled with the disease was evident long before the introduction of modern methods of public and private hygiene. In the British Isles, for instance, a gradual reduction is shown as far back as we have reliable statistics. Similar observations have been made in other European countries, and they indicate the operation of the law of adaptation by which individuals and races increase their resistance to agencies which act destructively and threaten their

⁶ Trans. Nat. Tub. Assoc., 1907, 191.

⁷ Wien. klin. Woch., 1904, xvii, 129.

⁸ Brit. Jour. Tub., 1908, ii, 20.

⁹ Ibid., p. 35.

¹⁰ Rend. R. Accad. dei Lincei, Roma., 1903, xii, p. 421; Zentralbl. f. Bakt., 1904, xxxiv, 708.

extinction, and transmit it to their posterity. Among their posterity there must necessarily occur differences and oscillations, and in unions in which one member possesses a less degree or none at all, the offspring's resistance represents but the average. In the negro race in the United States, which has suffered severely from tuberculosis during the last fifty years, the course has become less severe, and the chronic type is now observed much more frequently than twenty or twenty-five years ago. In more recent years I have observed latent forms more often than formerly, and recoveries are no longer such rare exceptions as they were at that time.

The special resistance which has thus been transmitted may gradually disappear in subsequent generations, when the defensive functions have not been exercised, or when they have become impaired by an unhygienic mode of life, or actual disease. We see this illustrated in families in which the disease skips one or more generations, only to appear again in the next.

Higher degrees of specific resistance to tuberculosis in man must be accepted in instances of latent infections and in those in which the disease appears to have been promptly arrested in its early incipency. Such latent infections have been discovered by Loomis,¹¹ Pizzini,¹² Kaelble,¹³ Harbitz,¹⁴ Weichselbaum and Bartel,¹⁵ Spengler,¹⁶ and others, and the tubercle bacilli, though apparently without power of pathogenic action in the individuals in whom they were found, were nevertheless shown to possess it, in the animal experiment. The frequency with which these authors found such latent infections at autopsies in which no evidence of tuberculosis could be shown, and the studies of Perez¹⁷ and of Manfredi and Frisco¹⁸ preclude the assumption that the bacilli had been deposited so recently that they had as yet not time to produce their characteristic tissue alterations.

The assumption of a specific resistance is justifiable and more rational for the interpretation of some of the minute non-progressive or obsolete and healed tuberculous lesions, which are so frequently found accidentally at autopsies and so often described in literature, that I need not cite particular statistics. In many such cases the nature of the lesion was confirmed by animal inoculation, showing, as in the instances of latent infection, that the bacilli had retained their virulence. More remarkable still are examples of extensive eruptions of tubercle, even of generalization in important organs, that have followed an apparently latent course. I refer more particularly to cases of generalized miliary tuberculosis in which no symptoms were produced until shortly before death, or in which a generalized affection was found accidentally at autopsy. Such

¹¹ Med. Record, 1890, xxxviii, 689.

¹³ Münch. med. Woch., 1899, xxxvii, 622.

¹⁵ Wien. klin. Woch., 1905, xviii, 241.

¹⁷ Ztschr. f. Hyg. and Infektskr., 1893, xiii, 347.

¹⁸ Zentralbl. f. Bakt., 1898, xxiii, 404.

¹² Ztschr. f. klin. Med., 1892, xxi, 329.

¹⁴ Jour. Infect. Dis., 1905, ii, 143.

¹⁶ Ibid., 1902, xxxii, 295.

cases were, for instance, reported by Hager¹⁹ and by Kollick.²⁰ In the cases of Wunderlich,²¹ or of Demme²² the entire course of the generalized disease had been symptomless, until the mechanical, irritative, and pressure effects from the coexisting meningeal tuberculosis caused death in a few hours. A mild and entirely afebrile course of miliary generalization, in which the number of tubercles or the number of organs involved offered no adequate explanation, is likewise suggestive of a specific antagonism to the bacillary toxins. If we add to such unusual observations the frequently observed healed lesions mentioned before and the spontaneous recoveries from more advanced stages of local tuberculosis, often under adverse conditions, we have better reason to consider them as evidences of a high degree of specific resistance than to ascribe them to accidents, or to freaks of Nature in which her best students know that she does not indulge.

Much more circumstantial evidence might be added to strengthen this side of the argument, but the facts stated may suffice for the consideration of the theory that man, although protected in various ways against the access of tubercle bacilli to his tissues, is primarily not resistant to their pathogenic action after an entrance has once been effected, even though his tissues be normal. The theory denies that tuberculous ancestors transmit to their descendants a specific predisposition of their tissues, by which the development of tuberculosis is favored; on the contrary, it affirms that under the law of adaptation there has been evolved a protective mechanism on the part of the tissue cells. This protective mechanism and its function differ in degree of development, and, therefore, in efficiency, according as they have been exercised more or less frequently and constantly in preceding generations and have been preserved by a normal hygienic mode of life. In instances in which the antagonism of this function is insufficient to prevent the primary localization and pathogenic action of the tubercle bacillus entirely, it may still retard its growth and modify favorably the course of the disease, thereby permitting a further increase through the specific stimulation by the bacillary products, the same as we observe it in other infectious diseases.

Without such a defensive mechanism, infections could but progress, and eventually destroy the organism. When we find this otherwise, and improvement and recovery occur, we are constrained to ascribe the contrary course to the intervention of a newly developed or increased power of defense which is also shown by the formation of specific antibodies in the blood serum. The amount and rapidity of their production varies with the infected organism itself, and with

¹⁹ *Deut. med. Woch.*, 1881, viii, 557.

²⁰ *Prag. med. Woch.*, 1901, xxvi; *Contribl. f. inn. Med.*, 1901, xxii, 606.

²¹ *Arch. f. phys. Heilk.*, 1859, iii, 283.

²² Cited by Cornet, *Nothnagel's Spec. Path. and Ther.*, Wien, 1901, Th. 2, Abth. ii, p. 41.

the biological characteristics of the related bacteria, and upon this variability depends, at least in part, the course of the disease.

When the required mechanism is present and its function is easily excited, when the amount of specific stimulation for this purpose is adequate but not excessive, then the organism protects itself promptly and efficiently; but when these conditions are not at all, or only partially fulfilled, the result varies accordingly. The mechanism and its functions are liable to be less perfected and less effective in localized infections like tuberculosis, in which the stimulus is inadequate because of the limited production and slow absorption of specific toxins from primarily small non-vascular foci; and, further, because the tubercle bacillus is but a slow grower, and is itself extremely resistant to disintegration. Under such conditions the resistance develops but slowly, and never attains as high a degree as it does in general infections. The influence upon the course of the disease is more frequently only that of a check clinically manifest by an intermission which lasts until a reduction occurs naturally in the course of time, or until adverse influences of a general nature and especially in nutrition have a like effect. Accessions and remissions follow thus, as we are accustomed to see them in the clinical course of phthisis, the former leading to further local impairment by advance of the disease.

The evolution of this function for the species as a whole must of necessity be slow, and even the attainment of a degree capable of modifying greatly the severity of the disease process, to say nothing of protecting against the infection entirely, may require centuries. Whether or not such an influence is now apparent in most of the infections with which the human race has battled in the past, as some students believe, we need not here decide, but the claim of competent observers, that infectious diseases previously unknown among a primitive race are unusually severe in their course, is suggestive.

In tuberculosis of the negro race I am inclined to the belief that the amelioration in severity in the course of the disease heretofore referred to may be considered as an evidence that a specific resistance begins to manifest itself, and if we are justified to look upon specific agglutinins for tubercle bacilli as an evidence of it, my own observations of their occurrence in apparently healthy full-blooded blacks, as well as in mulattoes, would give support to this view. Landis,²³ in a recent publication, has shown that the increase of agglutinins in chronic phthisis of negroes corresponds to that of white people, and he likewise found them present in such, who were in apparently vigorous health. Studies of immunity in tuberculosis are of more recent date and not enough comparative observations between so-called predisposed and not predisposed subjects have

²³ Jour. Med. Research, 1908, xiii, 19.

been made to corroborate fully the views here expressed. The occurrence, however, of specific agglutinins for tubercle bacilli in the blood serum of not a few persons who are apparently in good health, and with more or less frequency in newborn infants of mothers who have no demonstrable tuberculosis, would suggest a transmission of immune substances, while their almost uniform presence in tuberculous subjects shows their formation under the specific stimulus of the disease.

In the regular examinations of our patients in the Winyah Sanitarium we have practically never failed to demonstrate agglutinins excepting in cases in the cachectic stage of phthisis, although like others we have never observed a high degree of agglutinating power to develop in patients who have not been subjected to specific treatment. In cases in which the reaction occurs in apparent health in older children and in adults, it is of course possible that it stands in relation to a latent or healed tuberculous lesion not demonstrable clinically; but this could hardly be the explanation in the case of newborn infants whose mothers have no evidence of this disease. Examinations for other immune bodies in such cases will undoubtedly bring additional light as to their transmission. Being present in but small amounts in tuberculous subjects, and, as a rule, in still smaller amounts in those who are in apparent health, we would naturally expect that when transmitted the amount must be still less, and perhaps so small that they would not be demonstrable by the method usually employed.

In newborn infants Rosenberger²⁴ never found complete agglutination in dilutions higher than 1 to 1, or 1 to 3. Of the 27 infants which he tested, 15 gave no reaction at all. With a different culture of tubercle bacilli the results in another series of 39 newborn infants were positive in a still smaller number, and the almost entirely negative results of Salge²⁵ and the negative results of Descos²⁶ and of Cavazza,²⁷ and the few positive results observed by Anderodias²⁸ may, in part, have been due to unsuitable cultures.

In 8 of Salge's nurslings who were under one year of age and in whom there was a suspicion of tuberculosis, the reaction was positive. So far as concerns newborn infants the accumulated observations show that in a minority of cases agglutinins in amounts sufficient for demonstration may be transmitted by the mother, even if she be clinically free from tuberculosis.

In infants borne by tuberculous mothers the reaction is present more often, but the opportunity for making such tests is not frequently afforded to those who are most interested. (Hirigoyen²⁹

²⁴ Centrbl. f. inn. Med., 1904, xxvi, 665.

²⁵ Jahrb. f. Kinderhkl., 1906, xiii; Schmidt's Jahrb., 1907, cxcv, 75.

²⁶ Jour. d. phys. et de pathol. gén., 1903, v, 127; Baumgarten's Jahresber., 1904, xx, 571.

²⁷ Policlin. sez. prat. anno 11, fasc. 10; Baumgarten's Jahresber., 1904, 514.

²⁸ Soc. obstétr. Paris, 1903, Juin 26; Arch. gén. d. méd., 1903, ii, 1791.

²⁹ Gaz. hebdom. d. méd. et de chir., 1901, vi, 708.

tested one case and obtained a positive result.) In the two examinations made in my laboratory the mothers had been treated specifically to within several months of confinement, and their sera had at that time attained a complete agglutinating power in dilutions of 1 to 250 and 1 to 175 respectively. The serum of their babies' blood taken from the umbilical vein showed an agglutinating power in dilutions of 1 to 100 in the first, and of 1 to 80 in the second case. In the former the serum was likewise tested for specific amboceptor by Bordet and Gengou's³⁰ method and its presence was still shown in a dilution of one part of serum in 500, this having been the greatest dilution which was prepared. Thus it would seem that the degree of specific resistance as represented by the agglutinating power of the serum at birth bears a proportionate relation to that possessed by the mother during her pregnancy.

There is, however, reason to believe that transmitted immunity becomes diminished with increasing age; for this speaks for instance the communication of Bentzen³¹ who found that of 26 nurslings not over four months of age, all of whom were exposed to measles, only 4 contracted the disease, while of 47 others exposed between the ages of five and eleven months 35 acquired the infection. Other observations upon the frequency of acute infectious diseases in nurslings have been similar. Mossé and Daunic,³² Widal and Sicard,³³ Schumacher,³⁴ Hicks and French,³⁵ Staubli³⁶ and many others have shown the presence of specific agglutinins in the blood of infants born by mothers who during their pregnancy had suffered from typhoid fever; but most of the authors also found that they soon disappeared. Anderson,³⁷ and also Polano³⁸ have shown a similar relation experimentally in diphtheria; Figari³⁹ found immune bodies in the serum of the young of immunized goats, and these were further increased by suckling.

While agglutinins belong to the specific immune bodies, the one which is of greater importance for the demonstration of a true immunity is the so-called "amboceptor" which enables the germicidal part of the blood to act upon the foreign cells or bacteria, and although both are as a rule present in immune sera, the agglutinins may disappear, while the amboceptor function remains. Neither is there a necessary quantitative relation between the two, although both usually increase under active methods of immunization.

Until more recently my own studies were limited to specific agglutinins, the method for their demonstration being less complex, less difficult, and more rapid. My records of several thousand

³⁰ Ann. de l'Inst. Pasteur, 1901, xv, 289; Berl. klin. Woch., 1906, xxxiii, 1531.

³¹ Norsk. Mag. f. Laegevid., 1905, No. 7; Ctrbl. f. inn. Med., 1906, xxvii, 17.

³² Comp.-rend. Soc. d. biol., 1897, xlix, 238.

³³ Ibid., p. 804.

³⁴ Ztschr. f. Hyg. and Infktskr., 1901, xxxvii, 323.

³⁵ Lancet, 1905, i, 1491.

³⁶ Ctrbl. f. inn. Med., 1905, xxvi, 464.

³⁷ Jour. Med. Research, 1906, x, 241.

³⁸ Ctrbl. f. inn. Med., 1905, xxvi, 714.

³⁹ Riforma med., 1905, xxi; Schmidt's Jahrb., 1906, cexci, 63.

tests in approximately 500 patients examined show unmistakably that a high agglutinating power corresponds with a favorable course of tuberculosis. In more recent examinations for demonstrating the specific amboceptor, I have been able to show its presence in healthy persons with and without coexisting agglutinins, and have found that the amount may be large in tuberculous patients when the agglutinins are proportionally low in amount, and that like the agglutinins the amboceptor function can be increased under the administration of specific products of the tubercle bacillus.

I must now recur to the question of general resistance and consider its importance, which I may appear to have neglected. I have, however, indicated that the formation of immune substances is a cell function, and as this depends again upon normal cell nutrition it is apparent that the general health of the individual is not a negligible factor either in prophylactic hygiene or in the treatment of the actual disease. The integrity of the natural external protective agencies by which access of the tubercle bacillus to the tissues is hindered or prevented, likewise depends upon it. Disturbances of nutrition may, therefore, suspend or lower the specific resistance, and when continued, may cause its complete loss. Such observations have been made in experimental infections, when by starving, exposure to cold, poisoning, etc., animals naturally immune to a given infection have been made to succumb to it.

Normal nutritive processes have an opposite effect in favoring the elaboration of protective substances or preventing their loss, which is especially observable in chronic infections, both by experiment and clinically, and our system of general dietetic and hygienic treatment of tuberculosis rests upon these principles. Von Hanse-mann⁴⁰ has shown that they apply to plant life as well, by observing the difference between a poor unsuitable soil and a good one upon parasitic infection, the parasites disappearing spontaneously when the nutrition of the plants was improved.

Thus in the individual case in which the organism resists the infection or the progress of the disease, the lowering of the nutritive function may, and frequently does, disturb the balance in its favor, while an added improvement or the recovery of the lost balance acts in the opposite way.

The theory of specific resistance, as a substitute for a specific predisposition, tends to show that under the law of adaptation and the survival of the fittest, tuberculosis has in the course of time been changed from a rapidly progressive and usually fatal, to a chronic and more often self-limited disease, and that this is chiefly due to the development of a specific defensive apparatus against the tubercle bacillus and its toxins.

Inasmuch, however, as the efficiency of this apparatus is modified

⁴⁰ Die Deutsche Klinik, 1903, i, 665.

by its use or disuse and by the general nutritive integrity of the organism, it follows that there is little if any prospect that the disease will naturally disappear even in remote periods of the future, the less so, as, by reason of its local character, a high degree of immunity is never likely to be attained, because when effective enough to protect fully against infection in one generation, it will fail, by disuse and by unhygienic modes of life which lower it, to do this in succeeding generations. The disease must, therefore, fluctuate in frequency and severity, with perhaps a tendency on the whole to a more benign course. Reibmayr believes that upon these principles and with the aid of a better hygienic mode of life the human race must eventually work out its own salvation.

Studies in immunity since he wrote his treatise entitle us to hope that this may be anticipated by protective vaccination against tuberculosis, through which the attained resistance of the individual may be maintained and further increased. That in the manifest disease the therapeutic application of the same principle will greatly aid in securing actual and lasting recoveries, I believe to have amply demonstrated with others in the past seventeen years, since Professor Koch introduced his first crude tuberculin for this purpose. The value of this aid, although disputed and discredited by many observers, I learned to recognize in the first years of my work, and upon purely clinical observations the conviction was forced upon me then, that the action of tuberculin when properly applied was one of active immunization, limited in efficiency chiefly by the crudeness of the remedy and by the advance of the disease and coexisting complications.

Since then better preparations have become available and methods have been discovered by which their immunizing action can be shown in blood studies, which enable the observer to witness the development of immune substances and their increase to a degree which, in well-selected cases, soon exceeds manyfold that which has been shown to occur spontaneously under the much slower, and, as a rule, inadequate self-immunization through the same product derived from the bacillus and absorbed from the diseased tissues. Such studies and the permanency of clinical results have overcome the distrust in the method and have converted opponents into active supporters, and they have given a new impulse to specific treatment to a degree that I fear will once more lead to unjustifiable expectations.

Very little has as yet been attempted in the prophylactic use of specific products from which I am convinced their greatest benefit will eventually accrue, especially when we can find a still more effective vaccine and on that account also a quicker method. It is, however, quite possible that in subjects not as yet tuberculous, the present comparatively slow method can be greatly shortened, and experience must show to what degree prophylactic immunization

must be carried to assure protection against ordinary modes of infection. In the meanwhile the early glandular tuberculoses of young children, and the prophylactic application of the present method in those known to have been exposed, offer an attractive field, and in such and similar cases I have in the past seen most favorable changes in the general health and improvement in retarded physical development under specific treatment.

A CLINICAL STUDY OF THE EFFECT OF TUBERCULIN TREATMENT ON THE SERUM AGGLUTINATION OF TUBERCLE BACILLI.

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FOR several years the agglutination of tubercle bacilli by human blood serum has been investigated in the Saranac Laboratory, not only to see if the agglutination test is of value in the diagnosis of tuberculosis, but also to determine if the test can be used as a control during the course of tuberculin treatment. In a previous communication¹ we have reviewed the whole subject of the serum diagnosis of tuberculosis as employed by Arloing and Courmont. Our tests were made absolutely according to the directions given us by Dr. Paul Courmont in person. We found that the serum of healthy individuals agglutinated tubercle bacilli almost as frequently as did the serum of patients suffering from pulmonary tuberculosis (84.28 per cent. for healthy, and 87.09 per cent. for tuberculous persons), and that the agglutinating value in these healthy and tuberculous subjects was practically the same (13.67 for healthy, and 14.82 for tuberculous). We, therefore, agreed with Koch, Beck and Rabinowitsch, C. Fränkel, Romberg, and others, that the serum diagnosis of tuberculosis is of no value in the diagnosis of pulmonary tuberculosis. We next turned our attention to the effect of tuberculin treatment on the serum agglutination.

During his investigations into the relation of cattle to human tuberculosis, Koch felt compelled to apply the agglutination test as a means of differentiating the two bacteria, and first attempted to follow the method of Arloing and Courmont. He found, however, that their method was too complicated for practical use, and

¹ AMER. JOUR. MED. SCI., October, 1906.

that it did not give uniform and reliable results. He therefore prepared an emulsion of pulverized tubercle bacilli.² When a test is made with Koch's test mixture, diluted to 1 to 10,000, it is found that the greater part of the reaction has occurred at the end of fifteen to twenty hours. In our tests we gave a limit of twenty-four hours. The length of time of the reaction, the temperature at which the tests are made, and the amount of mixture must always be exactly the same.

With this emulsion tests may be made either in the morning or afternoon. They are placed in the incubator at 37° C. over night, and then examined the following day. Serums should be used clear, and should be as fresh as possible. In all our tests serums from fifteen to twenty-four hours old were used. It is necessary that an absolutely certain macroscopic appearance be accepted as the limit of agglutination, if one desires to obtain comparable data. At the limit of agglutination there should still be present macroscopically a loose, clearly distinguishable, and evenly distributed precipitate.

In his experiments on animals, Koch found that in order to give rise to the agglutinating power, and when it is already present, to increase it, it was necessary to have marked, and if possible, strong reactions from tuberculin. Agglutination usually first shows itself several days after the injection. It reaches the highest grade in from seven to ten days and then slowly sinks. It is, therefore, necessary to make the agglutination tests in from seven to ten days after the injections, in order to obtain the highest degree.

When animals are treated with cultures of bacteria with a view to immunization, there regularly appear in their blood in addition to the agglutinating, also immunizing properties, presumably of bactericidal nature. Koch, therefore, took it for granted that in his animals, if they were brought artificially to a more or less high agglutinating power, there was produced a certain degree of immunity. He leans to the view that the agglutinating power is to be classed with the immunizing properties, and considers that the degree of agglutinating power and the immunity stand to one another in a certain relation, at least at the beginning of the immunizing process, and that the agglutinating power is a standard for the grade of immunity produced.

There is produced from tuberculosis under natural conditions no, or very little, resisting substance in order to permit it to come to cure and resulting immunity. The question forced itself upon Koch, namely, after it is possible, with comparative ease, to raise in animals the agglutination and amount of resisting substances so extraordinarily, whether it is not possible, by means of artificial production of resisting substances, to assist the human organism in

² Deut. med. Woch., 1902, Nr. 88.

its struggle against tuberculous disease. He believed that he solved this matter in a satisfactory way by the agglutinating method, since he considered that this method informed him whether he was on the right path with his immunizing experiments.

First of all he ascertained on animals, in what form, dose, and method of application tubercle bacilli cultures must be employed in order to produce agglutinating values as soon and as high as possible. He then cautiously transferred to man the experiences thus obtained.

It turned out that pretty high agglutinating values exist if the entire substance of the tubercle bacillus is injected subcutaneously. The bacilli, however, must be worked up to a fine powder in order to be absorbed.

In his earlier immunizing experiments, Koch divided the powdered tubercle bacilli by centrifugation into two parts: into the undissolved residue (T.R.) and the supernatant fluid (T.O.). The T.R. again rubbed up and sedimented gave relatively weak, the T. O. strong reactions. In order to avoid reactions as much as possible, he gave T.R. the preference. By the help of the agglutination test he found that it is better to use the culture mass unseparated, and that the agglutinating power in man occurs surest and quickest when not too slight reactions occur, and when high doses are reached as quickly as possible. This is Koch's latest tuberculin, and is called Bacillen-emulsion.³

As a rule his first subcutaneous injection of this preparation was 0.0025 milligram. (This is always estimated as bacillus substance). He then increased the doses very quickly, with pauses of from one to two days, each time about from two to fivefold, until he came to very pronounced reactions with temperature elevations of from 1.5 to 2° C. (that is, 2.7° to 3.6° F.). When a strong reaction of this kind occurred he advised that much longer pauses should be made. As a rule he waited for six to eight days and longer, indeed, after the result of the agglutination test. Every patient was tested for the presence of agglutinating power before beginning treatment, and again just after the first two or three reactions. When the agglutinating power appeared positive, or if already present, it was increased by the injection, this degree of agglutination was maintained, and, when possible, pushed still higher. Koch, therefore,

³ Koch makes his tubercle vaccine, which he calls Bacillen-emulsion, in the following way: He takes 1 part pulverized tubercle bacilli with 100 parts distilled water to which equal parts of glycerin are added. To make a good emulsion take a large agate mortar, and slowly add the glycerin and water to the tubercle powder so as to have a thorough mixture. This mixture remains standing several days. It is then poured off from the coarse particles no longer in suspension, and so kept. 1 c.c. of the preparation corresponds to 5 milligrams of pulverized tubercle bacilli. (N. B.—This is really not so, because, when the emulsion stands for several days, so that the coarse particles may sediment, a considerable amount of bacillus substance is lost, and each cubic centimeter of the Bacillen-emulsion may then contain only 2 or 3 milligrams of bacillus substance. It may then, however, be standardized to contain 5 milligrams to each cubic centimeter.)

never reduced the dose and did not repeat the same dose, but always increased it. Otherwise the agglutinating power soon sank, and the advantage obtained was again lost. With subcutaneous injections he increased to doses of 20 milligrams, in individual cases even to 30 milligrams. The larger doses of 10 to 20 milligrams were given by him only in pauses of from two to four weeks.

Occasionally the agglutinating power sank in spite of the continuously increased dose. In such cases he regularly succeeded by intravenous injections of the preparation in increasing the agglutinating power in a surprising way. For this he employed only a liquid obtained by powerful and long centrifugation, and from which all suspended ingredients were carefully separated. He then treated his patients by beginning with subcutaneous injections, and continued with intravenous injections as soon as reactions appeared. Reports of seventy-four patients treated in this manner were, on the whole, favorable, but further reference to these or similarly treated cases have not appeared since to our knowledge.

EMPLOYMENT OF THE AGGLUTINATING TESTS AT THE SARANAC LABORATORY. In our endeavors to test the value of the agglutinating methods on man as a means of control while giving our tuberculin doses, and to compare our results with those of Koch, we were at once confronted by a grave difficulty. Dr. E. R. Baldwin found that the large laboratory animals were occasionally made dangerously sick by repeated intravenous injections of tuberculin, especially emulsions, and that several of them died soon after the injections when they were given in this way. We, therefore, considered that the intravenous method of giving tuberculin injections was accompanied by great danger and that it should not be employed on man. As a result, all our tuberculin injections on man were made subcutaneously. Another difficulty in the way of comparing our results with Koch's was that he sought to produce reactions as soon and as pronounced as possible, and to reach high doses as quickly as possible. We sought to avoid them altogether, if possible, and we frequently carried our patients to large doses of tuberculin—to 1 gram of old tuberculin, or 2 milligrams Bacillen-emulsion, with either no or few reactions. The period of time over which treatment continued was also very different; with Koch it lasted six months or longer, while with us it frequently lasted eighteen months or longer. Our investigation was thus not a test of Koch's method of giving Bacillen-emulsion as controlled by the agglutination test, but to see if the agglutination test was of value to control tuberculin injections, when these injections were given subcutaneously, and according to the slow or progressive method. The agglutination tests were made not only with Koch's agglutinating emulsion, but also simultaneously according to Arloing and Courmont's method, and with their "A" homogeneous bacillus. Comparative results of these two methods were thus obtained. The

plan of the investigation was to test the agglutination before tuberculin treatment was begun, and then from time to time through the course, and finally at the end of treatment. Tests were made at varying intervals after the dose, but usually in from seven to twelve days.

The character of the cases given tuberculin treatment differed from Koch's. A few were incipient, but most of them were advanced cases without fever and in good physical condition. With Koch many of the cases were advanced with fever.

Of the 15 cases treated by tuberculin, the following agglutinating power was obtained at some time during the course of treatment.

Koch's method.		Arloing and Courmont's method.	
1 to 10 . . .	0 patients.	1 to 10 . . .	1 patient.
1 to 15 . . .	0 "	1 to 15 . . .	1 "
1 to 25 . . .	2 "	1 to 25 . . .	5 "
1 to 33 . . .	2 "	1 to 33 . . .	4 "
1 to 50 . . .	4 "	1 to 50 . . .	1 "
1 to 75 . . .	3 "	1 to 75 . . .	0 "
1 to 100 . . .	1 "	1 to 100 . . .	1 "
1 to 125 . . .	0 "	1 to 125 . . .	1 "
1 to 150 . . .	1 "	1 to 150 . . .	0 "
2 cases not tested.		1 case not tested.	

Of 42 simultaneous tests by the two methods the results were the same in 8, and differed in 34. Of these 34 tests Koch's method had a higher agglutinating value in 19, and a lower in 15. The maximum degree of agglutination obtained at some time during the course of treatment was higher in 8 cases with Koch's method; was the same with both methods in 4 cases; and was higher with the French method in 1 case. Comparative results on this point were not obtained in the other 2 cases.

With Koch's method the observation of facts was very difficult, and it was sometimes impossible to determine the exact degree of agglutination. With the French method agglutination occurs in large flocculi, and the degree of agglutination can be seen even by an untrained eye.

In examining these 15 cases it is seen that the degree of agglutination increased in all except in one case. This occurred with both methods. It is interesting to note that with Koch's method, in the majority of cases, the maximum degree of agglutination did not occur at the end of treatment as one would expect, but at some time during the course of treatment. With the French method the agglutination was at its highest point at the end of treatment in 12 out of 14 fully tested cases. In spite of the fact, however, that the degree of agglutination would sometimes fall from its maximum point as the tuberculin treatment proceeded, we increased the doses in the usual way and did not observe that this fall in agglutination was accompanied by any deterioration in the health of the patient.

The important question to determine from this investigation is

whether the agglutination test, either by Koch's method or by that of Arloing and Courmont, is of any value as a control in giving tuberculin treatment as administered hypodermically according to the slowly progressive method. From an experience of over three years with these methods, we have not found them to be of any value. Neither method is sufficiently delicate to show slight variations in agglutination, and it was a common experience to see the agglutinating value fall, even when the patients were steadily improving.

EFFECT OF THE TUBERCULIN TREATMENT ON THE PATIENTS. Of the above 15 cases, 2 became clinically healed during a previous course of tuberculin, and were undergoing a second immunizing course. Two others received two courses of tuberculin treatment, but their condition at the end of the first course is now considered. We have, therefore, 11 cases to report upon. Of these 11 cases 2 were incipient and 9 were advanced. The 2 incipient cases became apparently cured; 1 of the advanced cases became apparently cured; and the 8 remaining advanced cases came to an arrested condition. Within a year 2 others of these advanced cases became apparently cured. In describing the results in these cases we use the terms according to the definitions employed by the National Association. Our aim throughout was to produce as few and as slight reactions as possible. Two patients reached 1 gram of old tuberculin with no, or a doubtful, reaction, 1 patient reached 0.51 gram of old tuberculin, 1 patient reached 0.68 gram of old tuberculin, and 1 patient reached 0.1 gram of old tuberculin with no reactions. In the remaining cases the number of reactions varied from 1 to 3. No harm was ever seen to follow fever reactions, and, although we tried to avoid them, yet we never felt any anxiety when they occurred. A notable feature throughout was the absence of hemorrhage in all the cases. Several of the patients had had hemorrhages previous to beginning tuberculin treatment, but practically no further blood-spitting occurred. We mention this fact as Meissen, of Hohenhonneff, thinks that tuberculin injections tend to produce hemorrhages. Our experience has been directly contrary to this, as those patients who have taken tuberculin treatment have been singularly free of hemorrhages.

SUBSEQUENT HISTORY OF THE TUBERCULIN-TREATED CASES. The 2 incipient cases have remained cured. Of the 9 advanced cases the one which was apparently cured at the end of treatment has since shown tubercle bacilli in her sputum. In the winter of 1907-1908 she developed a severe grip accompanied by bronchitis, and tubercle bacilli are now present in her sputum. In other respects she is in good condition, but is now classed as an arrested case. Of the remaining 8 cases which were classed as arrested at the end of treatment, 2 have since become apparently cured, 4 have kept on steadily improving, 1 has relapsed, and 1 died. We wish to express our strong conviction of the value of the tuberculin treatment on these cases as a whole.

	Remarks.	Koch's method.	Arloing and Courmont's method.
Case I. F. D. A.	Advanced (afebrile). No tubercle bacilli in sputum.	Not tested No agglutination	Agglutinated at 1 to 10 Not tested
Case II. F. D. A.	Cured case.	No test made + 1 to 50 + 1 to 10 + 1 to 15; \pm 25 to 33	+ 15 + 15; \pm 25 + 15; \pm 25
Case III. W. F.	Advanced (afebrile). Tubercle bacilli in sputum.	No agglutination + 1 to 25; \pm 1 to 50 No agglutination No agglutination No test made. + 1 to 5	Not tested + 1 to 25; \pm 1 to 50 + 1 to 10 + 1 to 10 + 1 to 10 + 1 to 50
Case IV. W. F.	Advanced (arrested). Tubercle bacilli in sputum.	+ 1 to 25 + 1 to 15; \pm 1 to 25 + 1 to 25	No test + 1 to 15 + 1 to 15; \pm 1 to 25
Case V. J. H.	Advanced (afebrile). Tubercle bacilli in sputum.	+ 1 to 5; \pm 1 to 10 + 1 to 5 + 1 to 33	+ 1 to 5 No test made + 1 to 33

Test made February 20, 1905, 9 days after 0.1 gm. old tuberculin.
Test made June 2, 1905, 31 days after 0.57 gm. old tuberculin.

At the end of treatment this case had no cough, no expectoration, and no tubercle bacilli, and the physical signs showed a healed lesion. He was classed as apparently cured. He had 2 reactions, the first at 0.0003 gm. and the second at 0.00029 gm., and then went to 0.57 gm. without reacting. The duration of treatment was 12 months.

Test made November 18, 1905, before beginning treatment.

Test made June 11, 1906, 8 days after 1.17 mgrm. Bacillen-emulsion.

Test made July 10, 1906, 9 days after 1.47 mgrm. Bacillen-emulsion.

Test made July 24, 1906, 7 days after 1.61 mgrm. Bacillen-emulsion.

This was an apparently cured case that was taking a second course of tuberculin treatment. He reached 1.69 mgrm. Bacillen-emulsion in 7 months without a reaction.

Test made before beginning old tuberculin treatment.

Test made November 26, 1904, 4 days after 0.026 gm. old tuberculin.

Test made January 11, 1905, 5 days after 0.055 gm. old tuberculin.

Test made February 7, 1905, 10 days after 0.1 gm. old tuberculin.

Test made March 27, 1905, 7 days after 0.1 gm. old tuberculin.

Test made April 12, 1905, 11 days after 0.11 gm. old tuberculin.

The maximum dose was 0.14 gm. At the end of this treatment this patient was a well-arrested case, tubercle bacilli were still in the sputum and he had cough, but the physical signs had much improved, as also had his general condition. He reached 0.140 gm. old tuberculin without reacting, but a little later had a slight reaction at 0.110 gm. Duration of treatment, 11 months.

Test made June 29, 1905, before beginning Bacillen-emulsion.

Test made November 2, 1905, 8 days after 0.68 mgrm. Bacillen-emulsion.

Test made February 3, 1906, 18 days after 0.7 gm. bacillen-emulsion.

This was an arrested case undergoing a second course of tuberculin treatment. He reacted twice at 0.68 mgrm. Bacillen-emulsion. The maximum dose was 0.7 mgrm. Bacillen-emulsion. Duration of treatment, 6½ months.

Test made before beginning old tuberculin treatment.

Test made October 26, 1905, 4 days after 0.00075 gm. old tuberculin.

Test made May 21, 1906, 10 days after 0.16 gm. old tuberculin.

At the end of treatment this patient had no cough, but still had very slight expectoration which contained a very few tubercle bacilli.

The physical signs had markedly improved. Five months later there was no cough, very slight expectoration, which did not contain tubercle bacilli. The physical signs showed a healed condition. She had four reactions, the first at 0.025 gm. old tuberculin, the second at 0.023 gm., the third at 0.029 gm. and the fourth at 0.16 gm. Duration of treatment, 22½ months.

Case VI. A. C. H.	Incipient (afebrile). Tubercle bacilli in sputum.	Test made October 5, 1905, before beginning old tuberculin treatment. Test made February 2, 1907, 8 days after 0.17 gm. old tuberculin. Test made May 30, 1907, 9 days after 0.155 gm. old tuberculin. At end of treatment this patient was apparently cured, and had no cough, no expectoration, and no tubercle bacilli. He had one reaction at 0.00013 gm. old tuberculin, and then went to 0.455 gm. without a reaction. Duration of treatment was 18½ months.	+ 1 to 25 + 1 to 25 + 1 to 50	+ 1 to 10; ± 1 to 15 + 1 to 25 + 1 to 33
Case VII. E. G.	Advanced (afebrile). Tubercle bacilli in sputum.	Test made February 20, 1905. Test made November 2, 1907, before beginning old tuberculin treatment. Test made February 2, 1907, 10 days after 0.188 gm. old tuberculin. Test made May 27, 1907, 10 days after 0.51 gm. old tuberculin. At end of treatment this patient was a well-arrested case; tubercle bacilli were still in sputum, but her general condition and the physical signs were much improved. No reactions. Duration of treatment, 18 months. Maximum dose, 0.51 gm. old tuberculin.	No test made + 1 to 15; ± 1 to 25 + 1 to 50 + 1 to 25	+ 1 to 25 + 1 to 25; ± 1 to 33 + 1 to 33 + 1 to 33
Case VIII. H. L.	Advanced (afebrile). Tubercle bacilli in sputum.	Test made January 14, 1905, at onset of treatment of old tuberculin. Test made April 17, 1905, 2 days after 0.0015 gm. old tuberculin. Test made July 10, 1905, 8 days after 0.01 gm. old tuberculin. Test made January 19, 1906, 12 days after 0.53 gm. old tuberculin. Test made March 16, 1906, 12 days after 0.68 gm. old tuberculin. At end of treatment this patient was a well-arrested case, had no cough, but still slight expectoration and a few bacilli; his general condition and physical signs had much improved. No reactions. Duration of treatment, 14 months. Maximum dose, 0.68 gm. old tuberculin. A year and one-half later the tubercle bacilli had disappeared from his sputum and he was at work, and was apparently cured.	No agglutination + 1 to 5 + 1 to 10; ± 1 to 15 + 1 to 75 + 1 to 25	+ 1 to 15 + 1 to 15 No test made + 1 to 25 + 1 to 25; ± 1 to 33
Case IX. D. C. M.	Advanced (afebrile). Tubercle bacilli in sputum.	Test made December 16, 1904, at onset of old tuberculin treatment. Test made April 17, 1905, 2 days after 0.005 gm. old tuberculin. Test made December 1, 1905, 8 days after 0.1 gm. old tuberculin. At end of treatment the patient was in a well-arrested condition; he had a slight cough, and slight expectoration, and a few tubercle bacilli; the physical signs and his general condition had improved. No reactions. Duration of treatment, 10 months. Maximum dose, 0.114 gm. old tuberculin.	No agglutination No agglutination + 1 to 75	+ 1 to 10 + 1 to 5; ± 1 to 10 + 1 to 10
Case X. J. P.	Advanced (afebrile). Tubercle bacilli in sputum.	Test made December 21, 1904, at onset of old tuberculin treatment. Test made July 3, 1905, 8 days after 0.01 gm. old tuberculin. Test made January 19, 1906, 12 days after 0.53 gm. old tuberculin. Test made April 7, 1906, 11 days after 1 gm. old tuberculin. At end of treatment this patient was apparently cured; had no cough, no expectoration and no bacilli; the chest showed a healed lesion. Test made July 25, 1906, 3 months after 1 gm. old tuberculin. No reactions. Duration of treatment, 15 months. Maximum dose, 1 gm. old tuberculin.	No test made + 1 to 10; ± 1 to 15 + 1 to 75 + 1 to 15	+ 1 to 5 No test made + 1 to 15; ± 1 to 25 + 1 to 10
			+ 1 to 10	+ 1 to 25

Case	Remarks.	Koch's method.	Arloing and Courmont's method.
Case XI. J. P.	Advanced (afebrile). Tubercle bacilli in sputum.	+ 1 to 15 + 1 to 15; \pm 1 to 25 + 1 to 10; \pm 1 to 15 + 1 to 15; \pm 1 to 25	+ 1 to 5 + 1 to 15; \pm 1 to 25 + 1 to 10; \pm 1 to 15 + 1 to 15
Case XII. A. P.	Midway between advanced and far advanced (afebrile). Tubercle bacilli in sputum. Had also laryngeal tuberculosis.	+ 1 to 5 + 1 to 33; \pm 1 to 50 + 1 to 33; \pm 1 to 50 + 1 to 75; \pm 1 to 100 + 1 to 150	+ 1 to 5 No test made + 1 to 10 + 1 to 10 + 1 to 15; \pm 1 to 25
Case XIII. L. M. N.	Midway between advanced and far advanced (afebrile). Tubercle bacilli in sputum.	+ 1 to 50 + 1 to 75; \pm 1 to 100 + 1 to 50 + 1 to 25	Varied from + 75 to 125 + 1 to 75 + 1 to 75 + 1 to 125
Case XIV. G. R.	Apparently cured (afebrile). No tubercle bacilli in sputum.	No agglutination No test made	No agglutination + 1 to 75; \pm 1 to 100
Case XV. G. R.	Apparently cured (afebrile). No tubercle bacilli in sputum.	+ 1 to 50 + 1 to 15; \pm 1 to 33	+ 1 to 5; \pm 1 to 10 + 1 to 15

SUMMARY.

Case.	Amount of agglutination at onset of treatment.		Maximum agglutination.		Amount of agglutination at end of treatment.		Remarks.
	Koch.	Arloing and Courmont.	Koch.	Arloing and Courmont.	Koch.	Arloing and Courmont.	
I	Not tested	1 to 10	....	....	No agglutination	Not tested	Maximum dose, 0.57 grm. old tuberculin
II	Not tested	1 to 15	1 to 50	1 to 25	1 to 33	1 to 25	Maximum dose, 1.61 mgrm. Bacillen-emulsion
III	No agglutination	Not tested	1 to 50	1 to 50	1 to 5	1 to 50	Maximum dose, 0.14 grm. old tuberculin
IV	1 to 15	Not tested	1 to 25	1 to 25	1 to 25	1 to 25	Maximum dose, 0.7 mgrm. Bacillen-emulsion
V	1 to 10	1 to 5	1 to 33	1 to 33	1 to 33	1 to 33	Maximum dose; 0.16 grm. old tuberculin
VI	1 to 25	1 to 15	1 to 50	1 to 33	1 to 50	1 to 33	Maximum dose, 0.455 grm. old tuberculin
VII	Not tested	1 to 25	1 to 50	1 to 33	1 to 25	1 to 33	Maximum dose, 0.51 grm. old tuberculin
VIII	No agglutination	1 to 5	1 to 75	1 to 33	1 to 25	1 to 33	Maximum dose, 0.68 grm. old tuberculin
IX	No agglutination	1 to 10	1 to 75	1 to 10	1 to 75	1 to 10	Maximum dose, 0.1 grm. old tuberculin
X	Not tested	1 to 5	1 to 75	1 to 25	1 to 15	1 to 10	Maximum dose, 1 grm. old tuberculin
XI	1 to 15	1 to 5	1 to 25	1 to 25	1 to 25	1 to 15	Maximum dose, 0.55 grm. old tuberculin
XII	1 to 5	1 to 5	1 to 50	1 to 25	1 to 150	1 to 25	Maximum dose, 1 grm. old tuberculin
XIII	1 to 50	1 to 125	1 to 100	1 to 125	1 to 25	1 to 125	Maximum dose, 0.3 grm. old tuberculin
XIV	No agglutination	No agglutination	Not tested	1 to 100	Not tested	1 to 100	Maximum dose, 1.02 mgrm. Bacillen-emulsion
XV	1 to 50	1 to 10	1 to 50	1 to 15	1 to 33	1 to 15	Maximum dose, 1.45 mgrm. Bacillen-emulsion

In conclusion, we wish again to state that in our hands the agglutination test has not proved itself of value to control tuberculin administration when given to cases with pulmonary tuberculosis. We consider that the only reliable means which we have at present to govern such cases is to observe them carefully after each dose of tuberculin, and to be acquainted with even the slightest signs of reaction; in other words, that the clinical method is at present the most reliable method to govern us when giving tuberculin treatment to cases of pulmonary tuberculosis. We have had no experience in the use of the agglutination or opsonic method in surgical tuberculosis, although the latter appears of value according to some workers, referring to Wright's school.

THE VALUE OF RÖNTGEN-RAY EXAMINATION IN THE DIAGNOSIS OF PULMONARY TUBERCULOSIS, ESPECIALLY IN REFERENCE TO EARLY TUBERCULOSIS.¹

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ALMOST all recognized radiologists have expressed themselves concerning the value of Röntgen-ray examinations in the recognition of early pulmonary tuberculosis. In addition to Professor Rieder, I may name Albers-Schönberg, A. Köhler, Holzknacht, Immelmann, Levy-Dorn, Bade, Hildebrandt, Gocht, Schellenberg, and Grunmach; in America, Williams and Walsham; and in France, Beclere. Even today opinions as to the value of the method are by no means clear. Advance, of late, however, is to be noted, inasmuch as the enthusiasts, whom we heard in the early days of the Röntgen era, have been silenced, and among the fewer well-informed the belief has been awakened that it is only necessary to take the fluoroscopic screen in hand to detect at the apex of the lung the smallest tuberculous change. Today the majority of physicians are opposed to x-ray examinations in early tuberculosis, but according to my belief unjustly so. This comes in largest part because, from the first, more has been expected of x-ray diagnosis, than a priori is possible for it to give. It cannot and never can lead to an absolutely certain diagnosis, when even with all clinical and bacteriological methods of examination such diagnosis is impossible. I believe, further, that this never will be possible, notwithstanding all anticipated improvements in the technique. Anything different is not to be expected. How often it is our experience

¹ Read at the International Congress on Tuberculosis, Washington, D. C., September-October, 1908.

that other methods, for example, the chemical, bacteriological, and even the anatomical, are not in a position to give a clear interpretation of pathological relations. Even with these methods frequently the conclusion is *non liquet*.

I purpose here not to review critically the opinions of all observers as I glean them from their contributions and, in part, from their expressions of opinion, but to state, with due regard to the results of the investigations of other authors, my own observations as to the manner and extent in which the x -rays have served me in the diagnosis of early tuberculosis. These conclusions are based on my extended experience in the medical clinic at Breslau and in the medical polyclinic at Jena.

I. First a few words about the technique of x -ray examinations in pulmonary disease: Among a large clientele, especially if it is composed of ambulatory patients, the fluoroscope is preferable. X -ray photography costs too much in time and money, and is, on that account, to be reserved exclusively for special cases. If the fluoroscopic screen is to be employed in a correct, profitable way, the following points must be considered:

1. The examining room must be darkened in the most complete way possible. An examination in a room in which, from unexcluded daylight, all objects may be recognized is thoroughly inadequate, and to my mind impossible. In spite of this, I saw within the last year, in an x -ray laboratory, that this factor important to a successful examination was not entirely fulfilled.

2. The x -ray tube must be placed in an absolutely light-tight box so that the fluorescent light of the x -rays is completely masked. The usual method formerly employed of excluding the rays by means of a dark cloth proved entirely inadequate. Covering the x -rays with a pasteboard box or a screen is likewise insufficient. If delicate distinctions are to be detected in the fluorescent light of the Röntgen screen, it is absolutely requisite that no other disturbing light phenomena shall enroach. The room must always remain absolutely dark during the use of delicate tubes.

3. The fluoroscopic box must be provided with a lead covering to protect the patient and the operator against the baneful influence of the x -rays.

4. The box must be so hung as to be easily movable, in order that the tube may be manipulated without difficulty.

5. The arrangement of diaphragms must be as good as possible. My experience is that the slit diaphragm is to be preferred to the round diaphragm for fluoroscopic examinations of the apices.

It is obvious that to obtain satisfactory results a good, luminous barium-platinum-cyanide screen is necessary. Likewise the eye of the operator must be rested, so as to be completely adapted to darkness. In this last respect all of us have frequently failed, when amidst the rush of a large clinic or dispensary there was not

time enough to wait for this. When the result of an examination is doubtful, the time must be found. Upon coming from daylight, which is bright or even dull, at least three to five minutes should be spent in the dark room, in order to rest the retina before proceeding with the examination. Through this slight delay the ability to detect delicate differences on the screen will be materially increased.

If the Röntgen photograph is to be employed, it is well to use for this purpose the diaphragm plates of Albers-Schönberg, if possible, in the dorsoventral and ventrodorsal diameters. Recently I used with advantage the examining chair devised by Albers-Schönberg for this work. First of all, with the slit diaphragm, the apices of the lungs are brought into the best possible focus with the patient in a sitting position. Following fixation the plate is inserted and an exposure of fifteen to twenty seconds is made with the full strength of the tube. The round diaphragm also gave good results.

II. Since in early adult pulmonary tuberculosis we expect differences in the transparency of the apices, it is both desirable and valuable to learn whether in persons, in whom beyond question there is no difference to be found at the apices by means of percussion and auscultation, there exist differences in regard to the transparency and expansion of the apices of the lungs. In order to answer this question I have looked over 80 previously collected cases of my own, in addition to about 180 suitable cases from our wealth of clinical material (we had 5880 patients in the Medical Polyclinic at Jena during the past year) which, along with Dr. Friedrich, I have examined with especial reference to this. In this conjunction I will briefly mention that undoubtedly conditions exist which make the normal lung apex appear dark with the fluoroscope. Among these conditions are the following: (1) Changes in the skin (scleroderma and edema of the skin). (2) Marked increase of the subcutaneous fat (general obesity, lipoma formation). (3) Enlarged, caseous, indurated, calcified lymph glands, which lie in the supraclavicular fossa or in the superficial or deep cervical region. (4) Remarkably good musculature. This is more marked especially on the right side than on the left; on this account noticeable röntgenoscopic differences occur. (5) Aside from the four above noted points, now and again darkening of the apices is seen because of the blending of the shadows of the clavicle and first ribs, or because the apices are unusually deeply placed. If these observations are taken into consideration, in order to avoid errors, one should carefully inspect and palpate before giving an opinion as to the results of *x*-ray findings, or even before making an examination; usually also before the fluoroscopic examination.

From my own experience there also occur in doubtful pulmonary cases, in which the above sources of error have been excluded, slight variations in the transparency of the lung apices. They are,

indeed, only slight, but in the future will cause me to control regularly the fluoroscopic examinations of doubtful cases by means of the x -ray picture. As regards the expansion and height of the apices, in unproved pulmonary cases slight differences are also noted by the x -ray examination. In a series of observations carried out under the direction of Professor Gerhardt at the Medical Polyclinic in Jena, Dr. Seufferheld obtained from examination of the apices by physical examination results that were to be expected, that is, slight differences in the percussion note and variations in the breath sounds. Further, Kronings, in some interesting examinations, discovered that there exists congenital, but little understood, malformations of the apices (heteromorphia and heterotopia). These also can cause röntgenoscopic variations.

III. What can we accomplish, with attention to the enumerated points, by means of x -ray examinations in early tuberculosis?

A. Early Tuberculosis in the Adult. In adults we look for and find, with ordinary clinical methods of examination, for the most part, a lesion at the apex; in early cases frequently only a catarrh, in further advanced cases infiltration processes. In a large number of these there are only uncertain findings—differences of pitch, uncertain roughened breathing, and prolonged expiration. If infiltrations are present, the air-containing tissue is replaced by airless or rather air-poor tissue. In such cases we see, provided the infiltration has progressed sufficiently, instead of transparency, a deep or moderately deep shadow, according to the extent of the lesion. If the infiltration extends to or into the neighborhood of the surface of the apex, we may recognize it by percussion, auscultation, and röntgenography. If it exists in the centre of the apex, without approaching the surface, or if isolated, unusually large confluent emphysematous bubbles have formed above the infiltration process (as I found explained by autopsy in a particular case), the infiltration is not recognizable by percussion. On the other hand, such lesions are seen excellently with the fluoroscope and x -ray pictures. I dispose of those examination findings which confirm or supplement our clinical findings in an unexpected way. In addition, in many cases in which we have positive dulness and in which a decided shadow is to be expected, our clinical findings are proved, inasmuch as the extent of the infiltration is shown to be greater than was expected.

I have convinced myself, by the method of Albers-Schönberg, that infiltrations exist, which, even with good diaphragming, can either not be recognized or only very uncertainly recognized by means of the fluoroscope. On the other hand, they give absolutely certain findings on the plate, especially with diaphragm pictures.

Thereto in part belong those cases in which we have uncertain percussion findings, merely slight catarrh, or only doubtful percussion and respiratory signs. Under these conditions, we obtain

differences in the fluoroscopic picture of the apices, just as we did in unrecognizable pulmonary disease. In such patients the photograph asserts its importance and is indispensable.

In patients who give apical findings suspicious of tuberculosis, without having frank auscultatory or percussion signs, we repeatedly see well-marked darkened apices, which do not clear up upon repeated deep inspirations. Besides, in these patients the photographic plate repeatedly shows not only a reduced air-content, recognizable by a cloud-like shadow, but also a circumscribed shadow, seen over deep-seated infiltrations. When both apices are equally or only slightly darkened, I have grown cautious with the röntgenoscopic diagnosis, because I have often found that by means of systematic weekly or bi-weekly breathing exercises the apices have cleared up very considerably.

In regard to the height of the apices, no significance can be attached to slight differences. If there exists a difference of 1 to 2 cm., especially if associated with alterations in the transparency, the presence of contraction may be inferred. I have also taken up röntgenographically the width of the apices, in sagittal section. Krönig has taught widely throughout medical circles the importance of determining this by means of percussion. Some time ago Freund again pointed out the importance of ossification of the first costal cartilage in the beginning of pulmonary tuberculosis. This led to proof of the early ossification of the costal cartilages by means of the x -rays. Immehnann and F. M. Grödel have paid especial attention to this and have reported suggestive results. It is, however, advisable that further studies be undertaken along this line.

A certain importance seems to have been attached to a symptom described some years since by Williams, that is, the lagging of the movements of the diaphragm on the affected side, even in the early stage of incipient tuberculosis. Statements to the contrary notwithstanding, I personally cannot attach any diagnostic importance to this symptom. I have failed to find it in somewhat over half the cases. With the object in view of proving this, I intend to make measurements of the extent of the excursion of the diaphragm movements. It seems to me that at present, Williams' phenomenon cannot find application as an aid to the early diagnosis of tuberculosis of the lungs.

If we ask the question, whether the signs elicited by the x -rays permit of a positive diagnosis, or whether the changes that are observed can be interpreted as especially tuberculous, or whether they can also occur in diseases of other genesis, as from the inhalation of dust or anthracosis, we can only give a provisional answer. To my mind these processes have nothing specific about them; we cannot see with the x -rays tuberculous processes in the strict sense; we see only the condensation of tissue caused by the tubercle bacilli. The fact is, that we need clinical methods in order to determine the

diagnosis of tuberculosis; the *x*-ray findings do not suffice. Furthermore, whether the change which exists is active or passive cannot be determined. Therefore, I practise fluoroscopy as a method which is to be regarded somewhat the same as bacteriological methods are regarded in relation to percussion and auscultation; but like them it is not enough alone to determine the clinical diagnosis of tuberculosis.

B. Early Tuberculosis in Children and Young People. In many cases we find the apices of the lungs free from disease. Above all, we further know, through the anatomical findings, that pulmonary tuberculosis of children and young people begins in the glands at the hilum of the lungs. Frequently clinical examinations fail or give ambiguous results. By means of the fluoroscope (good diaphragming is always essential) or the *x*-ray photograph, changes in the hilum shadows can be shown positively (that is, shadows of enlarged calcified glands) which are not revealed by any other method.

I now desire to call attention to a type of early pulmonary tuberculosis which occurs in youth. We frequently see a disease characterized by all the symptoms of a central pneumonia—high fever, rapid pulse, rusty sputum, and pneumococcic bacteremia. Through the aid of the fluoroscope we can demonstrate a more or less extensive, deep shadow. After a number of days, about five to nine the fever disappears, but by the fluoroscope and photographs it can be noticed that the shadow has not become more transparent. In fact, in the course of the succeeding week, extension occurs, frequently first seen as string-like shadows tending toward the periphery. In my cases the subsequent gradual recurrence of fever and finally the presence of tubercle bacilli in the sputum proved that, as a matter of fact, the condition was tuberculous. This clinical course seems not uncommon in younger people.

For the recognition of tuberculosis of the bronchial glands examination by the *x*-rays is absolutely indispensable.

CONCLUSIONS. *A. What x-ray examination furnishes in early tuberculosis of the adult.*

1. Infiltration processes at the apex, recognizable by percussion, which have a known extent, give a more or less deep shadow with the fluoroscope. The *x*-ray examination is frequently superior, as compared to the clinical, since it demonstrates that in many cases the process is more extensive than would be expected.

2. Infiltrations, either not demonstrable by percussion or only uncertainly so, can frequently be demonstrated by means of the fluoroscope; or when fluoroscopic results are doubtful, certainly by *x*-ray photography, diaphragm pictures. Besides, by this method it will not infrequently be shown that we are dealing with a more advanced case than was suspected.

3. The early stages of pure catarrhal processes are recognizable

neither by fluoroscopy nor by röntgenography. In long standing catarrh the results of poor aëration are seen with the fluoroscope as darker apices which do not clear up on inspiration. In important cases photography, in the shape of diaphragm pictures of the apices, should at once be employed. Beginning infiltrations are frequently recognized by this method which are not recognizable by any other.

4. The height of the apices, in doubtful cases determined by orthodiagraphic measurements, is only of importance when differences of 1 to 1.5 cm. exist. The width of the apices of the lungs has not yet been sufficiently studied röntgenographically to find employment diagnostically. Calcification of the first rib is well shown by diaphragm pictures, and according to Freund can be used as an aid in the diagnosis of incipient tuberculosis. The clearing of the apices with respiration, which is present in health, is frequently lacking on one or both sides in early tuberculosis. Movement of the diaphragm is altered in many ways; a unilateral lagging of the diaphragm on the affected side (Williams' phenomenon) cannot be classed as a special symptom, and, therefore, diagnostically is of no value. Orthodiagraphic measurements are needed. From a diagnostic standpoint the existence of rib shadows in x -ray pictures is either not to be taken into account at all, or if so, only with caution.

B. What x-ray examinations furnish in early tuberculosis of children and young people. In most cases apical findings are wanting; hence the recognition of shadow variations at the hilum are all the more important. These variations are due to bronchial glands enlarged as the result of induration, caseation, and calcification, and infiltration processes in the neighborhood of the hilum and bronchi. Frequently the picture of a central pneumonia following pneumococcic infections is seen in these conditions; then without fever the process, röntgenoscopically at least, slowly advances, and after weeks is recognized as tuberculous, both by percussion, auscultation, and bacteriologically.

Furthermore, in well advanced pulmonary tuberculosis x -ray methods of diagnosis furnish very well, frequently surprisingly well, a supplementary picture to the clinical findings, both with the fluoroscope and with x -ray photography. By this method we often see that which we know by autopsy findings, namely, that the tuberculous process is considerably further advanced than we supposed from our clinical examination. If, as so frequently happens, an extensive peribronchial infiltration exists about the main bronchi of the lower lobe, a very characteristic picture is obtained with the fluoroscope. In addition, by means of x -ray diagnosis those infiltration foci which develop from the bronchial glands—clinically they often begin with the picture of a central pneumonia—are found and discovered with certainty. Moreover, they may be recognized positively as tuberculous if they are a direct continuation of the bronchial gland shadows, especially in the adolescent.

As a valuable addition to our methods of diagnosis, it is noteworthy that it is possible by means of the x -rays to recognize positively tuberculosis of the bronchial glands, which formerly we guessed at from the interpretation of the clinical picture. Calcified or chalky foci or glands are seen with remarkable clearness as well at the hilum as within the lung; frequently they are as sharply defined as foreign bodies. The recognition of indurated and swollen glands offers more difficulty. The first give a sharp picture with good diaphragming; their recognition requires practice above everything else. Medullary swelling or caseation of glands are only to be differentiated from lung tissue if the glands occur in large masses which project into the lighter lung tissue. I must emphasize, as an absolute necessity, in the x -ray diagnosis of bronchial gland tuberculosis, careful clinical observation with the aid of all known methods, the tuberculin reaction, etc. To be sure, the Röntgen picture will show an atypical or pathological condition at the hilum or in the pulmonary glands; but whether it is an active or passive process can only be determined through clinical observations.

We can diagnosticate cavities with great certainty with photographs, but, as a matter of fact, rarely with the fluoroscope. Those cavities can also be recognized which because of their deep position, are otherwise not amenable to diagnosis. That form of tuberculosis which first appears with the clinical picture of caseous pneumonia—dulness of lobar distribution, and loud bronchial breathing, often for a long time without catarrh—gives a less intense shadow than croupous pneumonia. As a matter of fact, I have only been able to confirm this by autopsy in two cases.

THE TREATMENT OF TINEA TONSURANS.

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Few cutaneous diseases are more obstinate and stubborn to successfully combat than ringworm of the scalp. Because of the anatomical peculiarities in this locality, as well as the character of the usual infecting organism, it is much more difficult to bring about a cure here than in the bearded region. In the majority of instances (about 90 per cent.) *Trichophyton microsporon* (Audouini) is the hyphomycete which attacks the scalp. First becoming lodged in the stratum corneum, it multiplies there, giving rise to scaling and slight vesiculation. The growth then extends into the hair follicle and down the sides of that cavity, forming a sort of mosaic basket work encircling the bulb. Beneath this collar the cuticle becomes frayed and broken, probably as the result of the action of a kerato-

lytic ferment associated with the presence of the fungus, and allows the mycelium to penetrate into the body of the hair. Multiplication takes place both immediately beneath the cuticle and in the interior of the shaft proper. There is little if any pus formation, and the inflammatory changes in the perifollicular tissues are not, as a rule, marked. On the other hand, the lesions in deep seated tinea sycosis are almost invariably due to infection with the large spored ectothrix, and the tendency to inflammation and pus production, by both the plant itself and the ever-present pyogenic cocci, is very great. The tissues are loose and distensible, and a considerable reaction to the freely liberated toxins is quickly manifested, with resulting development of kerion-like, nodular masses. This process of stimulating the skin to destroy or throw off the fungus constitutes Nature's method of eliminating the disease, and it is a remarkably effective one. The same process is often instituted artificially, especially in those cases in which the scalp is involved, by the application of powerful irritants, such as formalin, chrysarobin, and croton oil. Needless to say, considerable care and skill are required in order to secure only the desired results. Permanent baldness of the affected area is not an infrequent sequel.

The direct method of treatment, in which entire dependence is placed on anti-parasitic remedies, such as sulphur, ammoniated mercury, and the various salts of copper, incorporated in diverse vehicles, is far safer, although extremely slow because of the difficulty experienced in getting the agent to penetrate the entire depth of the hair follicle.

In 1897 Schiff and Freund,¹ of Vienna, suggested the use of the x-rays as a depilatory agent, preliminary to the application of the antiseptic, and reported a series of cases successfully treated in this manner. Later, Hahn and Albers-Schönberg,² Kienboeck,³ Sabouraud,⁴ and others also reported gratifying results, and at the present time the value of the measure is universally recognized. Where the rays are available this combined treatment is undoubtedly the one to be preferred. Sabouraud, who is one of its foremost exponents, gauges the radial dose by means of his "pastilles" (the radiometer of Sabouraud and Noire), and is consequently able to bring about epilation with from one to three exposures, thus minimizing the danger as well as the length of time required for a cure. Unfortunately his mode of procedure has not proved practicable in this country, probably because the indicators, which are manufactured only in France, deteriorate with climatic changes and the lapse of time.

The exposure must be of sufficient length to produce a slight

¹ Wien. med. Wochenschrift, 1897, p. 856.

² Münch. med. Woch., 1900, pp. 284, 324, and 363.

³ Arch. f. Derm. und Syph., 1901, p. 132.

⁴ Annales derm. et syph., 1892; "Les trichophyties humaines," Paris, 1894; "La Dermatologie Topographique," Paris, 1905.

reaction in the deeper layers of the skin and yet not great enough to set up secondary changes which will lead to atrophy of the papillæ and consequent permanent baldness. Inasmuch as the individual susceptibility to this rather imperfectly understood force varies considerably, the dividing line is not nearly so definite and clear cut as could be desired. In the absence of an uncomplicated, practicable instrument for measuring the quality and intensity of the rays, experience, coupled with a considerable working knowledge of the tube to be used, must be relied upon to secure the necessary result.

The employment of an energetic antiseptic, both before and for a considerable time after the hair is removed, is to be advised, otherwise the disease is almost sure to persist and continue to spread.

Although the rays exert no direct influence on the fungi, the reaction to which they give rise constitutes an inflammatory process which is destructive to the organisms, while the depilation of the infected hairs not only removes many of the hyphomycetes, but, most important of all, opens up new and essential avenues for the successful application of antiparasitic remedies. It was while in search of these latter, in May, 1907, that my attention was particularly drawn to this subject, and since that time I have been carrying on an intermittent series of experimental inoculations, rabbits being employed for the purpose. The first subject (No. 1) was a male white rabbit, and it required repeated efforts, extending over a period of eleven weeks, to infect him successfully with a small spored ringworm obtained from the hair of a four-year-old patient in the University Clinic. After this experience I confined my attention, in animal experimentation, to the ectothrix.

The two affected patches which finally resulted were roughly oval in outline and measured 0.5 x 1.5 and 1 x 2 cm. One was on the right hip, the other above and in front of the right flank. Both were covered with a short, irregular stubble of broken hairs, the interstices being crowded with fine, grayish white, powdery scales.

There were no inflammatory areolæ, and very little vesiculation. The lower patch, including a 1 cm. margin, was surrounded with lead foil and subjected to an eleven-minute exposure from a Piffard model cancer tube at a low vacuum, the window being placed 6 cm. from the area. Under like conditions a ten-minute exposure is generally sufficient to bring about the desired result on the human scalp.

Ten days later, in the absence of any perceptible reaction, a second exposure, of twelve minutes, was given. Fifteen days after this the long hairs surrounding the area became loosened and commenced to fall out, denudation being complete at the end of a week. The resulting bare surface was equally divided, from above downward, by a line drawn with a sharp-pointed indelible pencil, and the anterior half thoroughly covered with the following mixture: Iodine crystals, 1.75; potassium iodide, 1.25; goose grease, 25.

In explanation I will say that for a considerable time both my associate, Dr. Kanoky (with whom the idea originated) and I have been employing a combination of iodine and mercury for topical antiseptics with most excellent results. The ordinary tincture of iodine is first mopped on the surface, and this is followed, a few minutes afterward, by the application of a 2 per cent. aqueous solution of mercuric chloride. The powerful effect secured is due not to the individual action of either agent alone, but to a third, mercury iodide, an extremely active and powerful, but relatively unstable, salt which is formed at the points of contact.⁵ In a previous series of experiments on animals I demonstrated the superior value of goose grease as a skin penetrant.

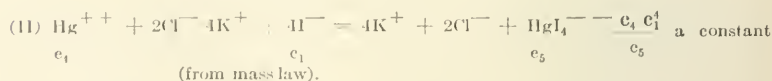
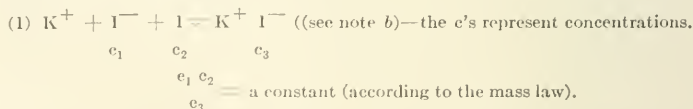
A portion of each half of the bald spot was excised, under chloroform anesthesia, fastened in a wooden vise microtome block, frozen by means of the ethyl chloride spray, and sectioned in a direction as nearly parallel as possible with the follicles and from below upward. The bits of tissue were immediately transferred to a filtered solution of strained honey (10), glycerin (20), and water (70), and later examined in the same media. Unfortunately, owing to the method of cutting, the sections were too thick for finer differentiation with the oil immersion, and the lenses employed (Ocular 4 and Objectives 4 and 9, Reichert) failed to reveal any inflammatory changes. It could be seen, however, that the iodine

⁵ The reaction which takes place is explained, by Prof. Roy Cross, A.M., M.D., of the Department of Chemistry, as follows:

Formula, No. 1.		Formula, No. 2.	
KI	5	HgCl ₂	2
I ₂	7	Goose grease	100
Goose grease	100		

In No. 1 the iodine dissolves in the goose grease and the KI is mechanically mixed with it. In order that a reaction may take place, a common solvent must be present, and this is furnished by the skin when the ointment is applied. The KI solution then takes up its equivalent of iodine as is present in the formula (see reaction (I) and note a).

When the HgCl₂ ointment is applied in quantity equal to or greater than No. 1, the complex salt, potassium mercuric iodide, and iodine are formed. The final active agents are practically the K⁺ ion, the complex HgI₄²⁻ ion, and the molecular iodine. The reactions, with their general mechanism, follow:



When ointment No. 2 is added reaction (II) takes place and c₁, in both mass law equations, is diminished. Therefore c₂ is increased, or, in other words, molecular iodine is formed.

NOTE a.—See laws of distribution—Oswald, "Grundlinien der Inorganische Chemie;" also Nernst, "Theoretical Chemistry."

NOTE b.—KI is practically completely dissociated into K ions and I ions in solution, and its properties are dependent upon these ions.

mixture had penetrated to the bottoms of practically all the follicles in the treated area, as well as to a considerable depth in the appended glands. Quite a number of fungi remained in the cavities, along with small portions of broken hair cuticle, and their presence explained the frequency with which re-infection occurs, even when all of the shafts have been removed.

On June 3, 1907, the upper patch, which had not been rayed, was treated with the iodine-geese grease mixture, heat (from a 50 C. P. focussed incandescent lamp) and friction being employed. A half-hour later a 2 per cent. solution of mercuric chloride in goose grease was applied. This gave rise to a slight degree of irritation, which subsided about four days afterward. The application was repeated on the 10th and 17th. On June 30 the patch showed decided signs of improvement. Unfortunately, I had to leave the city and did not see the rabbit again for two months. At that time the skin was apparently normal macroscopically, and it was not possible to outline the former affected area.

In the latter part of September I was able to secure some excellent specimens of the ectothrix from an extensive case of ringworm of the body, the disease having originally been contracted from a pet kitten. The non-cultural differentiation of the corporeal types in man can best be made, as White has pointed out, by the examination of an infected lanugo hair.

Two white rabbits were shortly afterward successfully inoculated from these scales. In both animals the affected areas showed a much greater tendency to become raw and inflamed than in rabbit No. 1. Animal No. 2 developed a large, irregular patch on the right upper shoulder, a smaller, almost circular one on the right flank, and a third, roughly oval in shape, on the left side of the trunk. The area on the shoulder was depilated by one fourteen-minute exposure from the Piffard tube, denudation being practically complete at the end of two weeks. The bare surface was given a thorough coating with the iodine-geese grease mixture, followed by the corrosive sublimate. Three days later a portion from the centre of this patch was excised, prepared for sectioning, mounted in celloidin, cut, and stained by the Unna-Pappenheim method. The signs of inflammation, both in the walls of the follicles and the perifollicular tissues, were not very marked; in fact, the changes were not greater than one would expect to find in ordinary, untreated, ring-worm infected tissue. From these and similar findings made subsequently I judge the curvative effects of the mercurial salt are due more to its antiseptic properties than to its action as an irritant.

The infected area on the left side of No. 2 was given an exposure of fifteen minutes, the patch in the right flank being treated with the iodine and mercury solutions at the same time. On the twelfth day following, the skin on the left side showed considerable evidences of inflammation and many of the hairs in the rayed area could be

readily extracted from their follicles. The loosened shafts were removed as thoroughly as possible by friction and the separate antiseptics well rubbed in. In the meantime the spot on the flank had received four treatments with the solutions, both heat and friction being employed. All medication was discontinued on November 15.

Hair development was slow in the depilated area. My notes record, on January 18, the appearance of "a fine lanugo-like growth scattered over the surface," and the outline could still be plainly discerned two months later.

The patch in the right flank improved quite rapidly, almost from the time treatment was first instituted. It still appeared a trifle "moth eaten" on January 1, but was apparently normal four weeks later, an examination of hairs and curette scrapings proving negative.

The disease manifested itself rather slowly in No. 3. Only two patches developed, and in both it seemed as if the organisms confined their attack mainly to the outer layers of the epidermis. There was some hair involvement, however, in addition to very considerable scaling and the formation of numerous minute vesicles, the latter being especially plentiful around the openings of the follicles. The x-rays were not used on this animal, four applications of the antiseptic, at three day intervals, being sufficient to bring about a cure. A similar satisfactory result was secured in the case of a fourth rabbit, infected in March, 1908, with the ectothrix.

In five clinical cases, all children, treated with the mixture since February 1, the results have been very satisfactory. The microsporon was the causative fungus in each instance.

One of these patients, a girl of five years, presented the most intractable example of the disease that I have ever encountered. The scalp was attacked at ten or a dozen different points, and new patches were developing and the old ones extending, in spite of treatment. This was due, in a large measure, to the neglect of the mother, who failed to carry out the instructions given her. The affected areas were finally depilated (by the fractional method of Sabouraud) and the disease checked, and ultimately eradicated, by the use of the iodine-mercury solutions. While I have never seen any untoward effects following the employment of these drugs, care has always been exercised not to cover too large a field at one time, 30 or 35 square centimeters being about the limit for a child of eight years.

No one realizes better than I the dangers of generalizing from a too limited experience or from insufficient data, but the excellent results secured by this method of treatment, especially in the earlier stages of the disease or as a postdepilatory measure, certainly speak strongly in favor of its routine use in this extremely intractable affection.

REVIEWS.

DISEASES AND SURGERY OF THE GENITO-URINARY SYSTEM. By FRANCIS S. WATSON, M.D., Lecturer on Genito-urinary Surgery in the Harvard Medical School. Assisted by JOHN H. CUNNINGHAM, JR., M.D. 2 vols.; pp. 1101; 454 engravings and 47 colored plates. Philadelphia and New York: Lea & Febiger, 1908.

IN THE accomplishment of his purpose to write this book the senior author labored—like Jacob for Rachel—seven years, but, more fortunate than the patriarch, was able to secure a collaborator for the last three. The outcome is a useful addition to the literature of genito-urinary surgery, an excellent compendium of modern opinion on that subject, and a reliable guide to the operator, partly through the numerous statistical tables of mortality—and other—results, but chiefly by reason of the careful descriptions of the details of approved operative methods.

Volume I deals with the external genitals, prostate, and bladder. The article on chancroid is brief, but satisfactory, though some rather antiquated and space-consuming tables of Fournier's might, with advantage, have been omitted.

The article on cancer of the penis is an abstract of a paper by Barney.¹ A certain carelessness is shown in the arrangement of this material. Under the heading, "Contact with Cancerous Cervix," Barney says: "In this series"—meaning his whole series of 100 cases—"there was not even a suggestion of this being an etiological factor." Later, under "Nationality," he says: "It is worthy of note that the Jewish race does not figure in this list of nations." Watson runs these two statements together under the former heading, with the result, in effect, of asserting, first, that *no one* acquired penile cancer from contact with a cancerous cervix; next, that no Jews acquired it in that way! The matter is worthy of mention because it renders obscure an important and significant clinical fact with an obvious bearing, not only on penile cancer, but also on circumcision and on the causation of cancer in general. In this relation, too, may be noted the use, between quotation marks, of an

¹ Annals of Surgery, December, 1907.

excerpt (page 52) from the same article, but with omissions that are altogether unindicated. This occurs elsewhere (*e. g.*, p. 341) more than once. In every case the omissions have obviously been made for the sake of brevity, and no perversion of meaning has resulted; but the custom is indefensible. A quotation altered in any respect should invariably have such changes indicated in one of the usual ways. In the second example mentioned the result is a paragraph of slovenly English that the writer quoted from would certainly prefer to repudiate, and in the above instance Dr. Barney's omitted figures give point to the otherwise bald statements as to modes of origin.

The text might here and there be bettered as to lucidity. Thus, in discussing the interesting instances in which in the absence of doubtful intercourse—or even of any intercourse—the gonococcus is apparently present in the discharge of a urethritis, the authors describe such a case as one in which “the patient has not had sexual connection and could not have had it for so long a time previous to the appearance of the disease as to make a gonorrhœal contagion possible.” This surely might be improved upon as to clearness; “within such a time” would perhaps be preferable. We would not refer to an “occult reason as yet unknown” (p. 60), or say, “this picture is a very different one from the violent course pursued,” etc. (p. 73), or “the practice and special knowledge demanded . . . is too great” (Vol. II, p. 181); nor would we write, “White and Martin speak as follows: They say,” etc. (p. 58); we would similarly prefer not to split the infinitive—“to absolutely interdict” (p. 62), (though we know Professor Lounsbury's views on that subject); and we certainly would not say, in writing of gonorrhœa, that “we *personally* prefer the ordinary urethral syringe for the acute stage of the disease” (p. 64), (the italics are ours), though we would cordially join in a preference not thus qualified. The expression seems a favorite one, as the writers say of the treatment of gonorrhœal lymphangitis, “Personally we do not believe in cold applications” (p. 67). Throughout there is some similar looseness of expression to be found—if sought for—but it would be hypercritical to lay much stress upon it.

Undue confidence is expressed in sandalwood oil and in argyrol in the treatment of specific urethritis.

Somewhat more recent statistical—and other—information as to gonorrhœal ophthalmia might be obtained than by reference to Keyes for the old figures of relative frequency (14 to 1), as compared with gonorrhœal conjunctivitis, which were quoted from Fournier by Van Buren and Keyes in 1877, and have been re-quoted ever since. The treatment recommended (quoted from Keyes, who quotes from Knapp) in the latter and graver condition fails to mention the great importance to others of immediate isolation of the patient.

The views of Dr. Otis with respect to urethral caliber are accepted as accurate by the authors. Many surgeons are now convinced that the relationship between the circumference of the flaccid penis and the urethral caliber is much less definite than Otis supposed, and that his figures are exaggerated and distinctly misleading when the urethrameter is used for diagnosis in the penile urethra, and its findings interpreted by his scale. We saw no mention of the similar errors in diagnosis that may result from the use of the bougie-à-boule in the deep urethra. In both cases normal narrowings may be—and frequently are—mistaken for strictures.

The teaching that divulsion "should have no place in the treatment of strictures" is so sound that it might have sufficed. It is weakened by the publication of a mortality table (including the figures of Holt—circa 1861), which *seems* to show that the operation "is neither more nor less safe than internal urethrotomy." To estimate the value of such tables it is sufficient to recall that in 1861 the use of urinary antiseptics by the mouth was unthought of as a preparation for operations on the urinary tract. Periods should be compared as well as cases. This is an example of a tendency often noticeable among statisticians. The habit of collecting figures not unnaturally seems unsatisfying unless conjoined with the habit of generalizing upon them. The author was awake to the danger of this when he wrote his preface, but he has nodded occasionally while preparing his text. It is to be remarked, with approval, that in the face of the too prevalent disposition to elaborate most surgical procedures, and to throw aside old and well-tried methods, he has had the courage to say that in hydrocele "the simplest and a very effective method of treatment is that of injecting the sac with carbolic acid or tincture of iodine."

The suggestion is made as to the cause of prostatic hypertrophy—that "the best, perhaps, that can be said is that at or after middle life the greater number of persons exhibit a tendency to fibrous formations of one or another structure of the organism, and that among these a very common one is that of the change which affects the prostate, although the changes are not confined to the connective tissue of the gland." This is both weak in theory and confused in language. It must be admitted that we can only guess on this subject, but to suggest that the underlying cause is a certain tendency to "fibrous formation," and then state—correctly, of course—that the prostatic growth is not merely such a formation, would seem, in the slang of the day, to entitle the authors to "guess again."

The subject is thereafter treated with much fulness and perspicacity, but the claims of perineal prostatectomy are presented in a too favorable light, and its disadvantages somewhat too lightly touched upon, while the very positive teaching in its favor rests largely upon a series of figures, some of which are repetitions and have no cumulative value, and all of which are undergoing change

as more and more cases are reported. Dr. Watson may be right, but he doesn't prove that he is.

His treatment of the chief foreign exponent of suprapubic enucleation, Mr. Freyer, seems more discourteous than is warranted by any facts with which the reviewer is familiar. To call Mr. Freyer a "universal usurper of previously preempted prostatic privileges" (p. 342) is cheap and undignified, and seems to display a bias that lessens whatever value the opinion of the author as to the controversy about "priority" might otherwise have. Moreover, it is tautological, as no usurped preempted anything could be other than "previous" in point of time. The mention of the beginning of Mr. Freyer's work—he went to London after resigning from the army and leaving India—as his "somewhat spectacular entrance . . . upon the scene" (p. 339), similarly suggests an attitude at least unjudicial. Caspar says, after mentioning Fuller and Watson: "In 1900 Mr. P. J. Freyer, of London, adopting and modifying the principle of Fuller's method, began the series of operations which have connected his name with suprapubic prostatectomy." (Second edition, p. 366, 1909.) That seems on its face a statement more likely to carry weight.

If it was worth while, for purposes of comparison, to publish mortality tables of castration and vasectomy, there is no good reason why the earliest tables (White's and Cabot's)—210 cases with a mortality of 16.2 per cent.—should have been selected, and the later one of Wood—159 cases with a mortality of 8.1 per cent.—should have been ignored. In the same relation a mortality of 8.3 per cent. is assigned to vasectomy, although Wood's and Rovsing's 233 cases show 13 deaths, a mortality of 5.5 per cent. If "conclusions" are to be drawn from figures—as in these instances they are drawn—it is obvious that the figures must be reliable.

The chapter on vesical calculus is a good *resume* of the subject. Among the possible contra-indications to litholapaxy might have been mentioned: marked chronic cystitis; calculi with an unerushable nucleus, such as lampwick; great atony of the bladder. It is difficult to see the advantage—in a book in which the surgery of the genitalia, bladder, and prostate is considered in only 599 pages—of devoting so much space to cuts of instruments. There are no less than seven cuts of evacuating pumps, including Bigelow's, Otis', Kegan's, Freyer's, Thompson's, Bird's, and an anonymous one, although the author expresses the sound opinion that none of them has materially improved upon Bigelow's original device.

Volume II, dealing with the kidneys and ureters, is an interesting and valuable portion of the book. The reason assigned by the author (following Glantenay) for the occurrence of movable kidney, viz., defective development of perirenal connective-tissue attachments to surrounding parts, although much emphasized as the "only explanation" with respect to etiology which "covers the

ground," seems altogether inadequate. In most cases such defect would certainly be incapable of demonstration as a precedent condition, and its existence would have to be assumed. The hypothesis does not explain the preponderance of right-sided cases (13 to 1), or the greater frequency in females (8 or 10 to 1). The argument that the downward pressure of the liver helps to account for the greater frequency on the right side is met with the curious statement that "it certainly does not explain the left kidney cases, and does not account for the right ones, else why should not all right kidneys be abnormally mobile?" The greater fixation of the left kidney, due to the fibrous bands which result from the fusion of the primitive parietal peritoneum and the surface of the primary descending mesocolon, is ignored. The author deals with the various factors generally accepted as contributory to undue mobility of the kidney in the same way; for example, rejecting the view that the shape of the renal—paravertebral—fossæ helps to account for both right-sidedness in all cases and the greater frequency in women (a view strengthened by the observations and dissections of Harris) because he has seen a movable left kidney in a young man "whose left paravertebral fossa was quite as deep and quite as well closed as is the case in subjects in whom there has been no such abnormal mobility of the organ."

The article on renal infection and suppuration is an admirable one. The diversity of opinion, to which he calls attention, as to "the relative frequency of unilateral and bilateral hematogenous renal infection or suppurative nephritis" is due in part at least to the assumption that the terms are ordinarily used as synonyms. He so uses them, but we do not believe this to be the rule. If suppurative nephritis is not of hematogenous origin—as it frequently is not—it is, of course, much more likely to be unilateral.

"Perinephric" abscess seems to us a better term than "perinephritic," as true inflammation may be absent (as in some tuberculous cases), or an abscess may have become "perinephric" by gravity and in the absence of any primary infection of perirenal tissues.

The chapter on renal calculus, that on renal and adrenal tumors, and that on genito-urinary tuberculosis, are worthy of careful study. In relation to tuberculosis of the epididymis and testicle, the author, after confessing that he is still in much doubt as to the rules that should govern the choice between palliative (or expectant) and operative treatment, gives a summary of the results of Bruns, and says, finally, that he "inclines to the opinion that it is a mistake to remove either or both testicles, except for the sake of cleanliness and comfort in the cases in which there is distressing open ulceration or suppuration, and to advise hygienic, tonic, and outdoor treatment for the larger number of these patients." If he means that he inclines to advise such treatment—and not that it is a mistake

to do so—we agree with him and believe his opinion to be sound and not unduly conservative.

The illustrations are of varied quality; some of the most ambitious (especially those in color) are flamboyant and impressionistic, and convey but little idea of the conditions supposed to be represented; others are too wooden and characterless. The general level, however, is high, and many of them—though diagrammatic—are models of what explanatory cuts should be. The anatomical plates—taken largely from standard authors—are good, as a rule, while the reproductions of the appearance of specimens are uniformly beyond criticism.

The book shows—with some exceptions such as those to which attention has been called—much care and industry in its preparation, and indicates throughout the undoubtedly extensive experience on which it is based. It fairly represents modern thought and modern practice, and goes far toward justifying the expectations of the friends and colleagues of the authors. In most of its mechanical features it could scarcely be improved upon. It deserves a place in the library of every genito-urinary surgeon.

J. W. W.

DISEASES OF THE SKIN AND THE ERUPTIVE FEVERS. By JAY FRANK SCHAMBERG, A.B., M.D., Professor of Dermatology and Infectious Eruptive Diseases in the Philadelphia Polyclinic and College for Graduates in Medicine. Pp. 534; illustrated. Philadelphia and London: W. B. Saunders Company, 1908.

THE author begins well by clearly defining dermatology as embracing "in its broadest sense the consideration of all morbid processes that are characterized by cutaneous manifestations," thus distinguishing this important branch of general medicine from the domain of the self-styled, petty "dermatologist," in which "facial blemishes," moles, corns, and warts constitute the principle diseases. Dermatology rightly defined is really an important branch of medicine. The work before us, though far from being a treatise, nevertheless portrays briefly and tersely the most important points in connection with each disease. The style is concise and practical, so that the reader who follows the text (too brief, as it sometimes is) and the numerous and excellent photographic illustrations should not fail to comprehend at least the elements of dermatology as the author understands and uses this term. Some of the chapters might have been fuller and others shorter; thus, the anatomy of the skin and the general symptomatology receive only a few pages, while general etiology is not touched upon. On the other hand, eczema, acne, and psoriasis receive sufficient space, consider-

ing the size of the volume. The "acute eruptive fevers" occupy, perhaps, one-third of the entire book, and constitute a valuable contribution, the statements made emanating from one who has studied these diseases in a practical and thorough manner from the standpoint of cutaneous medicine. There is also a chapter devoted to "acute infectious diseases, accompanied at times by eruptions," such as typhoid and typhus fevers, influenza, epidemic cerebrospinal meningitis, rheumatic fever, serum eruptions, and the like.

The nomenclature employed throughout is sensible, plain, and in harmony with most authors in this country. The term syphiloderma, we are pleased to observe, is employed in preference to the unsatisfactory French "syphilide," so often used, a word which should never have been permitted to find lodgement in an American or English text-book. The views expressed on all topics are conservative, safe to follow, and practical, and are well abreast of the knowledge of the present time, both as to general and special pathology, etiology, and treatment. Actinotherapy and radiotherapy receive considerably more than passing notice. Many rare diseases are briefly described, some with photographs, which, of course, add greatly to the value of the remarks. The illustrations throughout the book are largely original, and have been taken by the author, so well known for his skill in this field. The novel feature of the work, for a book of its size, is the consideration together of the non-febrile and the febrile cutaneous diseases, though this plan was successfully carried out fifty years ago by Hebra in his exhaustive and valuable treatise on diseases of the skin.

L. A. D.

NERVOUS DISEASES AND PSYCHIATRY. By CHARLES L. DANA, M.D., LL.D., Professor of Nervous Diseases in the Cornell University Medical School, New York. Seventh edition; pp. 782; 264 illustrations. New York: William Wood & Co., 1908.

THE publication of the seventh edition of a book on a special subject, like neurology, is perhaps the best commendation that reasonably can be hoped for. The foregoing issue of Dr. Dana's book contains not only the best of those that have gone before, but also additions to the sections on the histology of the neuron and the anatomy and physiology of the brain; re-arrangement and amplification of the sections on neurasthenia, hysteria, psychasthenia, and the methods of psychotherapy; and expansion of the sections dealing with neuritis, tabes, multiple sclerosis, brain tumor, the tics, and paralysis agitans. The book has long enjoyed an enviable reputation as one of the best moderate-sized treatises on neurology; the new edition, somewhat enlarged, considerably revised, in part rewritten, and enriched by many new illustrations, unquestionably will find added favor in professional eyes.

A. K.

THE MEDICAL AND SURGICAL KNOWLEDGE OF WILLIAM SHAKSPERE.
WITH EXPLANATORY NOTES. By JOHN W. WAINWRIGHT, M.D.
New York: Published by the author, 1908.

DR. WAINWRIGHT has collected a very interesting series of 135 or more quotations from Shakspeare that show his wide range of matters medical, if they do not suggest that the Bard of Avon actually studied medicine. The quotations embrace references to anatomy, physiology, medicine, surgery, obstetrics, neurology, psychiatry, therapeutics, dietetics, hygiene, ethics, jurisprudence, toxicology, and pharmacy. With some of the quotations we are tolerably familiar; others have long since passed without our ken; others are new. All have been drawn from unexpurgated early editions, and have been materially enhanced in value and interest by explanatory comments by Dr. Wainwright. There is a photogravure of the only authentic portrait of Shakspeare painted during his lifetime. Assuredly Dr. Wainwright's labor of love has been worthily accomplished; the book should prove a welcome addition to any library.

A. K.

ÉTUDE SUR LES CONTUSIONS, DECHIRURES, ET RUPTURES DU REIN
(STUDY OF CONTUSIONS, LACERATIONS, AND RUPTURES OF THE
KIDNEY). By DR. GEORGES LARDENNOIS, Prosecteur à la
Faculté de Médecine de Paris. Pp. 230; 22 illustrations. Paris:
G. Steinheil, 1908.

THE author's object in preparing a statistical study of nearly 800 renal injuries, 4 of which cases came under his own observation, was to determine the indications for operative interference. Until about 1900, surgeons in general were very conservative in their views of the proper treatment of these injuries; operation was recommended and adopted only as a last resort. Since that time, and up to the present, there have been done, in the opinion of Lardennois, a quite unnecessary number of nephrectomies for rupture. He finds, however, that early operation is attended by a lower mortality than if operation be postponed or not adopted at all. Among 666 cases in which the latter course was adopted, the mortality was 28 per cent., whereas among 102 patients treated by prompt operation, only 18 per cent. died, and as all the more serious injuries are included in the latter series, the difference is more striking than the actual figures indicate. Moreover, if from the above figures one excludes all cases in which complicating lesions rather than the injury of the kidney caused death, it is found that the death rate following expectant treatment was 25 per cent., while that after prompt operation was only 10 per cent.

He insists on the necessity of determining whether or not the kidney is ruptured at the earliest possible moment. Delay in reaching a decision may render adoption of proper treatment impossible. The main indication for operative intervention he thinks is the presence of a lumbar hematoma, especially if increasing in size; he regards this as a much more imperative indication than hematuria, which, comparatively speaking, is benign unless so profuse as to be accompanied by signs of very grave anemia. Among 59 early nephrectomies there were 14 deaths. So radical an operation is rarely necessary, and we think he quite properly urges suture and packing as preferable in almost all cases; for even though the uninjured kidney will undergo compensatory hypertrophy, and although the ruptured organ may be functionally equivalent, when cicatrized, to not more than one quarter of a normal kidney, yet it is well worth while to save even that much of a kidney for the patient.

A. P. C. A.

SUBCUTANEOUS HYDROCARBON PROTHESES. By F. STRANGE KOLLE, M.D. Pp. 153. The Grafton Press, New York, 1908.

SUBCUTANEOUS injections of paraffin for the correction of deformities of the face and other exposed parts of the body have become such a recognized method of surgical treatment that it is well to have the indications and the limitations of this method clearly defined. This the author appears to have done in the present volume. He recognizes the dangers and deficiencies of the method when ignorantly or carelessly applied, but takes pains to show how these may be avoided. He prefers paraffin with a low melting point, from 102° to 115° F.; and he makes the injections with the paraffin cold, using a specially constructed syringe, which by the screw action of its piston forces the paraffin out in a thread-like stream. These precautions prevent embolism, burning, excessive inflammatory reaction, etc. He insists on the necessity of injecting only a small amount at a time, and in no case attempting to overcorrect the deformity. This prevents subsequent sloughing and the necessity for the removal of the mass. He uses neither general nor local anesthesia, except in a few cases the ethyl chloride spray. He does not describe, and apparently does not commend the use of paraffin prothesis for the deformities left after excisions of the jaw, etc. There are some evidences of carelessness in writing, such as the expression "*vice a tergo*" (p. 61), and the statement (p. 3) that among the advantages of the so-called Gersuny method are the difficult surgical interferences entailed, and the subsequent unsightly cicatrices. These, no doubt, will be corrected in another edition.

A. P. C. A.

A MANUAL OF DISEASES OF THE NOSE AND THROAT. BY CORNELIUS GODFREY COAKLEY, A.M., M.D., Professor of Laryngology in the University and Bellevue Hospital Medical College, New York. Fourth edition; pp. 604; 126 engravings and 7 colored plates. New York and Philadelphia: Lea & Febiger, 1908.

THE present edition of this excellent manual has been carefully revised and some notable additions made to it. Thus, the section on diseases of the septum contains a concise but clear description of the submucous operation for deflections of that structure. We are glad to notice that Dr. Coakley still considers the guillotine of service in the removal of hypertrophied tonsils. Although tonsillectomy is undoubtedly the operation of choice in the majority of cases, nevertheless the guillotine has still a wide field of usefulness. It must be remembered that the guillotine is generally considered a very easily used instrument, and as such is used by many who never acquire the technique necessary for its proper employment. The reviewer thoroughly agrees with Dr. Coakley in his statement that it is a most excellent instrument for the removal of non-adherent tonsils. It is to be hoped that, in his next edition, Dr. Coakley will include an account of direct laryngoscopy and bronchoscopy, as these procedures have now been established on the basis of practical usefulness. We know of no other book of this class which can be more highly commended as a safe and reliable guide to the student of laryngology and rhinology.

F. R. P.

A MANUAL OF PSYCHIATRY. By J. ROGUES DE FURSAC, M.D., formerly Chief of Clinic at the Medical Faculty of Paris; Physician-in-Chief to the Public Insane Asylums of the Seine Department. Authorized Translation from the French. By A. J. ROSANOFF, M.D., Second Assistant Physician, King's Park State Hospital, New York. Second American edition. Pp. 406. New York: John Wiley & Sons; London: Chapman & Hall, Limited, 1908.

THIS is the second American edition of this work, the first one having been published in 1905. The previous edition was edited by Dr. Joseph Collins. The entire text has been thoroughly revised and all of the author's additions in the second French edition have been introduced. This book does not differ very much from the usual manual of psychiatry. As is customary, the first part is devoted to general principles, such as etiology and symptomatology, and the second to special psychiatry. With a few exceptions,

Krapelin's classification is adopted. The manner of treatment is very good, and the subject matter is briefly and well set forth. Besides, the translator, who has done his work very well, has added notes on psychotherapy, the after-care of the insane, and the technique of lumbar puncture. Altogether, it is a good book for the beginner.

T. H. W.

ANATOMIE UND MECHANISMUS DER SKOLIOSE. By DR. CARL NICOLADONI. Pp. 58; 37 plates (54 figures). Berlin: Urban und Schwarzenberg, 1909.

THE chief value of this little book, issued in pious remembrance of its author by his sister, and with a brief word of introduction by Hohenegg, lies in the admirable plates which fully illustrate the effect of torsion and rotation in the production of changes in the vertebræ and in their relation to one another. They show successively the topography of the thoracic and abdominal viscera; the changes in fasciæ and in the diaphragm; the alteration of the spine in different planes—horizontal, frontal, and sagittal; and the effects of lumbar scoliosis on the column and on individual vertebræ. A very brief summary and a bibliography of the literature of the anatomy and mechanism of scoliosis are added. The author's views as to predisposition, torsion, rotation, etc., are confirmed by these excellent illustrations. It was worth while to preserve and produce—even six years after the author's death—this valuable record of painstaking research into the fundamental causes of lateral curvature.

J. W. W.

INSOMNIA AND NERVE STRAIN. By HENRY S. UPSON, M.D. Pp. 142. New York and London: G. P. Putnam's Sons, 1908.

THIS volume deals with the effect of peripheral irritation on the central nervous system, and its influence on the production of various neuroses. The first half of the book is devoted almost entirely to case records of melancholia, mania, dementia præcox, hysteria, and neurasthenia. Examples of all these diseases are presented as cured following the removal of irritation from disease of the teeth. Many of the case records are incomplete, and the facts presented therein are insufficient for a diagnosis. This is more particularly the case in the examples of melancholia and dementia præcox. Notwithstanding these discrepancies, the results obtained from such a simple procedure as the proper examination and care of the teeth are rather startling. The second half of the book is a

psychological analysis of the neuroses. Nothing new is brought out; the analyses are poorly presented, and for the most part are not at all consistent with the accepted physiology of the cell and the nervous system. The subject matter presented in the volume would have made a good paper; presented in book form, it is somewhat disappointing. If it leads to a closer study of the teeth in conditions of lowered nerve tone, it will perhaps serve a useful purpose.

D. J. McC.

PATHOLOGICAL TECHNIQUE. A PRACTICAL MANUAL FOR WORKERS IN PATHOLOGICAL HISTOLOGY AND BACTERIOLOGY, INCLUDING DIRECTIONS FOR THE PERFORMANCE OF AUTOPSIES AND FOR CLINICAL DIAGNOSIS BY LABORATORY METHODS. By FRANK BURR MALLORY, A.M., M.D., Associate Professor of Pathology in the Harvard University Medical School; and JAMES HOMER WRIGHT, A.M., M.D., S.D., Assistant Professor of Pathology in the Harvard University Medical School. Fourth edition; pp. 480; 152 illustrations. Philadelphia and London: W. B. Saunders Co., 1908.

It is scarcely necessary to say anything in review of this excellent work, which has reached its fourth edition. The subject matter is treated with extreme clearness, and with such brevity as is possible in a book of its kind. Some of the improvements and additions that deserve mention are: the incorporation of Zinsser's anaërobic method for plate cultures, and three new methods for the cultivation and differentiation of the typhoid bacillus, the ox-bile method, the medium of Endo, and the malachite green method. The paragraphs on actinomycosis have been entirely rewritten and several excellent photographs have been added. Weigert's iron hematoxylin stain for nuclei; improved methods for staining fibroglia, myoglia, and neuroglia fibrils; Wright's method for the differential staining of blood platelets and the giant cells of the bone marrow; Best's improved stain for glycogen; von Kossa's silver method for demonstrating lime salts; staining methods for *Treponema pallida*; and Sir A. E. Wright's method of preparing bacterial vaccines, have also been added. As a standard book for laboratory workers in general it can be highly recommended.

J. A. K.

PROGRESS OF MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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Aortic Insufficiency and Lues.—CITRON (*Berl. klin. Woch.*, 1908, xlv, 2142) reviews the literature of aortic insufficiency and aortitis, and points out that the histological examination of the aorta in suspected luetic disease has thus far failed to reveal the presence of *Spirochæta pallida*. The frequency of aortitis in lues is, however, so great that a causal relationship must be assumed. Citron has reviewed the histories of patients with aortic insufficiency admitted to Professor Kraus' clinic in the past four years, and finds that only 14 per cent. gave a definite history of syphilis, while about 26 per cent. were suspected of having had the disease. In the past year and one-half the Wassermann reaction has been tried on all patients with aortic insufficiency, and of 19 cases it was positive in 11. In cases of pure aortic insufficiency—16 in number—10 gave a positive reaction. Without attempting to draw far-reaching conclusions from his few patients, Citron believes it safe to say that lues is a much commoner cause of pure aortic insufficiency than the history and clinical findings would lead one to suspect. Especially in all patients in whom acute articular rheumatism has not existed lues must be considered, but his cases have shown that a positive reaction may be found in instances in which acute articular rheumatism, lead poisoning, alcoholism, and abuse of tobacco were present and thus probably aided in producing the changes in the aorta.

The Substances causing High Pressure in the Blood of Nephritics.—SCHLAYER (*Münch. med. Woch.*, 1908, lv, 2604) had previously reported negative results on examining the blood of nephritics for adrenalin by the method of O. B. Meyer, which consists in the use of arteries obtained fresh from the ox. He found that the blood of nephritics caused even less contraction in the fresh artery than normal blood, whereas one should

expect a greater contraction if the adrenalin were increased in the blood. With the enucleated frog's eye mydriasis is the rule with nephritics blood. In an attempt to control these apparently contradictory results, Schlayer resorted to experiments upon animals. He produced an adrenalin anemia by slow infusion of adrenalin in salt solution. By this means an increased amount of adrenalin was brought into the blood, as was shown by the mydriasis in the frog's eye. On testing this blood with fresh artery from the ox he found that there was less contraction of the artery than with normal rabbit's blood, a result analogous to that obtained with the blood of normal individuals and those suffering with nephritis. On adding adrenalin to ox blood and then testing the blood with an artery, an opposite result was obtained, the adrenalin blood causing a much greater contraction than normal ox blood. From this and other experiments he was able to demonstrate that an increased amount of adrenalin in the blood would only react to a fresh artery when both blood and artery were obtained from the same species. He concludes, therefore, that the Meyer test is misleading when the artery of an ox is used for testing the blood from any other animal. This probably explains the contradictory results in patients suffering with nephritis and re-opens the question as to whether adrenalin is increased in the blood in these patients.

The Demonstration of Parasites in the Blood.—STÄUBLI (*Münch. med. Woch.*, 1908, iv, 2601) demonstrated some time ago that trichina embryos are easily found in the heart blood of experimental animals, if one adds to the blood 3 per cent. acetic acid to luke the red cells and then centrifugalizes the specimen and examines the sediment, which contains leukocytes and any embryos which are present. More recently he has shown that the embryos may be recovered from the blood of the ear vein of experimental animals by the use of this method (given below), though the number of parasites is much less than in the heart blood. In seven guinea-pigs he found one to three parasites in the blood, in five of these, using only 0.05 to 0.3 c.c. of blood. He therefore believes that it is highly probable that in man the blood obtained from the finger or ear in cases of trichinosis may show the parasites, and thus excision of the muscle may be obviated. In filariasis the parasites are often present in such number that they are readily seen in preparation of fresh blood. Stäubli has had one case in whose blood this method gave negative results, but by diluting the blood with acetic acid and centrifugalizing he was able to demonstrate the filaria. He suggests the use of his method of examination in other conditions which, however, seem less promising. In using Stäubli's method only blood which flows freely should be used, and the pipette should first be washed out with 3 per cent. acetic acid. The apparatus must be carefully cleaned before using. The blood is then diluted with 10 to 15 volumes of the acid; 3 per cent. acetic is always strong enough to cause complete laking of the red cells, but weaker solutions were found to be unsatisfactory in some cases. So far as Stäubli has observed the acid is not injurious to the parasites. After centrifugalizing the sediment is examined fresh or smears are made and stained, preferably with Giemsa's or Jenner's stain.

Basophilic Granulation of the Erythrocytes in Embryos.—NÆGELI (*Folia Hæmatologica*, 1908, v, 525) has examined the blood of the embryos of the rabbit, guinea-pig, mouse, sheep, and pig, and in all of these he found basophilic granules in the red cells. He believes the same results would be found in the blood of human embryos if it were possible to examine the blood of embryos not still-born. In some of his specimens more than 70 per cent. of the red blood cells showed basophilic granules. The results in all instances were comparable. Very interesting findings were obtained from examining rabbit embryos of different ages. All specimens were stained with Giemsa's stain. (1) Embryos 0.7 to 0.8 cm. long. Practically all the cells are polychromatophilic megaloblasts, with relatively large well-preserved nuclei. There were many mitoses (monasters and diasters), always with basophilic granules in the protoplasm. (2) Embryos of 1.4 to 1.5 cm. Very many magaloblasts, both orthochromatic and slightly polychromatic were found, none, however, with basophilic granules. Ninety-five per cent. of these megaloblasts show small blue particles of nuclear material, usually three to five in number, often collected in small colonies, but occasionally isolated. Rarely these nuclear derivatives, when situated close to the nucleus, are stained deep red. The first generation of the blood cells (the large forms) lacks basophilic granules. The second (smaller) generation of erythrocytes even now predominates. Normoblasts are very frequent, always markedly polychromatophilic, and some cells contain a central red mass of chromatin, others many fine basophilic granules. In cells in which the polychromatophilia is less marked basophilic granules are fewer and coarser. Normoblasts in mitosis are always strongly polychromatophilic and show basophilic granules. (3) Embryos 2.2 cm. long. The blood of these embryos shows many rather large orthochromatic red cells, often with basophilic granules and frequently with a red chromatin particle centrally placed. The normocytes are the same as in the last group. (4) Embryos 5 cm. long. The majority of all cells are orthochromatic normocytes with basophilic granules. Often these cells show a red nuclear particle centrally placed; frequently the nuclear particle is situated peripherally. In the latter arrangement, however, the basophilic granules are never found in the same cell. (5) Embryos 10 cm. long. The macrocytes are now lacking. Often one finds normocytes with centrally or peripherally placed nuclear particles. No cells are found which show basophilic granulation.

These results demonstrate conclusively the constant presence of basophilic granules in the blood of embryos. Whether the granules arise from the nucleus or the protoplasm, Nægeli is unwilling to state as yet. He describes and pictures three kinds of basophilic substances in red cells of embryos: (1) Red chromatin rests usually centrally placed, becoming gradually smaller with the increasing age of the embryo, may be found, especially shortly before birth. He has seen similar structures in pathological blood in man in cases of pernicious anemia, lead poisoning, and anemia pseudoleukemica. Not infrequently such cells show basophilic granules as well. (2) At times one finds one to two peripheral nuclear particles in the red cells, and these have also been found in pernicious anemia, lead poisoning, anemia from hemorrhage, and chlorosis. They represent the last remnant of the nucleus, and are not found in early embryonal life. (3) Particles which are apparently

snared off from the nucleus are found only in macrocytes and megaloblasts. When situated near the nucleus they stain red, while those peripherally placed are usually blue. They are readily stained with all nuclear dyes, and are easily demonstrated with the triacid stain. There is no connection between these and basophilic granules.

With the demonstration of large numbers of cells showing basophilic granules in the blood of normal embryos of all animals examined, a new and very important argument is brought forward for the regenerative character of these granules.

The Blood in Basedow's Disease.—GORDON and VON JAGIE (*Wien. klin. Woch.*, 1908, xxi, 1589) have made complete blood examination in 13 cases of Basedow's disease, including 7 incomplete cases, which they called Basedowoid. Normal red and white counts and normal hemoglobin were found, though occasionally a slight leukopenia existed (3500). Differential counts showed in nearly all a relative lymphocytosis up to 39 per cent., and a relative mononucleosis up to 13.5 per cent. In all cases in which the percentage of lymphocytes was normal, there was a marked increase of the large mononuclears, and the reverse was also true. They emphasize especially the value of these findings in the incomplete cases. The mononucleosis is to be explained by the splenic enlargement, which is not uncommonly found in this disease. They refer to the enlargement of the lymph glands, and think that this has something to do with the lymphocytosis.

Arterial Pressure in Tabes, and its Modifications during the Gastric Crises and Lightning Pains.—J. HEITZ and M. NORERO (*Arch. d. maladies du cœur, des vaisseaux, et du sang*, 1908, i, 505) have studied the blood pressure in tabes, especially in relation to the gastric crises and lightning pains, and find that in the former there is generally a marked vasoconstriction and hypertension, most probably secondary to the pain. Pain is possibly due to an irritation of the posterior roots, and is accompanied by the reflex phenomena of vomiting, constipation, and the vasoconstrictor influence which brings about the hypertension. This increase of the pressure is absent in those cases in which the pain is slight or absent. The hypertension becomes less marked in the older patients, possibly because the reflexes are interfered with in the progress of the lesions. The peripheral lightning pains are also associated intimately with the hypertension. As regards treatment, the inhalation of nitrite of amyl relieves the pains immediately, and this may be kept up even after the pressure has returned to normal. Injections of nitrite of sodium, 4 centigrams ($\frac{2}{3}$ grain) daily, do not seem to have any influence on either the pains or the hypertension. The gastric crises are accompanied by an acceleration of the pulse contrary to those in lead poisoning and gallstone colic. From their observations Heitz and Norero do not think that the cardiovascular system of tabetics suffers from the repetition of the pains as much as one would think.

The Inhibition of Pancreatic Activity by Extracts of the Suprarenal and Pituitary Bodies.—RALPH PEMBERTON and J. E. SWEET (*Arch. Int. Med.*, 1908, i, 628) have found that the suprarenal glands and the nervous portion of the pituitary body in dogs contain something which,

on extraction with salt solution and intravenous injection into dogs, cuts short the flow of pancreatic juice after the administration of secretin. It also prevents the stimulation of the gland by secretin if such an injection has preceded. This feature has been found up to the present time in no other tissues. It is independent of the general rise in blood pressure seen after the intravenous injection of adrenalin and pituitary extracts. The inhibitory factor of extracts of the suprarenal gland seems to disappear by decomposition, oxidation, or other processes before the blood pressure raising element has gone. It would appear that the suprarenal and pituitary bodies have at least one property other than those generally recognized as present in them.

Rheumatic Myocarditis.—CAREY COOMBS (*Quar. Jour. Med.*, 1908, ii, 26) notes the importance of the involvement of the myocardium in patients who have had rheumatism, and thinks that so much attention has previously been focussed on the pericardium and endocardium in rheumatic subjects that the myocardium has been more or less overlooked. In his study, Coombs has reached the following conclusions: That dilatation of both ventricles is constant and often of considerable degree. The auriculoventricular orifices share in the stretching. Hypertrophy of both ventricles is usually present, and in many instances without any obvious mechanical cause. The changes in the heart are mainly microscopic, and consist of slight fatty changes in the cells, but the important point is the formation of nodules in the stroma. They appear to constitute an inflammatory reaction, and are characteristic of rheumatic, as opposed to other forms of carditis; similar changes are seen in rheumatic endocarditis, pericarditis, and subcutaneous rheumatic nodes. The toxemia accounts, no doubt, for the greater part of the fatty changes in the cells, as well as the dilatation and hypertrophy. Coombs thinks that the physical signs characterizing the rheumatic heart disease of childhood are, in the majority of cases, referable to the myocardial lesion and not to those of the serous layers. Death during childhood from rheumatic conditions is frequently directly due to myocarditis, while in later life also some deaths are due to this same cause.

Tabes a Disease of the Deep Sensations.—J. GRASSET (*Scientific Series* 5, Montpellier, 1909) in this monograph presents a most thorough clinical study of the disturbances of the deep sensations in tabes, the various analgesias, the abolition of the deep reflexes, trophic changes, arthropathies, etc.; gives a thorough anatomical and physiological study of the disease; and notes the importance of the involvement of the sympathetic system. He concludes that tabes is a disease of the deep sensations, and that the disturbances of these play a more or less important role in each case; they are of such importance in its diagnosis that whether the picture be complete or not one cannot conceive of tabes without disturbance of the deep sensations, while no other group of symptoms is so indispensable in a picture of the disease. The disturbances of the deep sensations most commonly met with are the analgesias on deep pressure (epigastric, tracheal, testicular, ocular, tendons, bones, nerve trunks) or with disturbances of the stomach, heart, bones, and articulations and their consequences, hypotonia and the possibility of forced articular displacements, trophic disturbances, loss of tendon reflexes, loss of

muscle sense with its resulting ataxia. These are symptoms of a defect in the deep sensations, and the direct consequence of lesions in the posterior tracts. At the same time there are many other symptoms that become evident in a fully developed case of tabes which are more or less due to disturbances of the superficial sensations; it is impossible to picture a break in the working of the deeper sensations without the involvement of the superficial also. The disturbances of the deep sensations are, however, of more importance than the others and precede them.

Typhoid Meningitis.—E. E. SOUTHARD and E. F. RICHARDS (*Jour. Med. Research*, 1908, xix, 513) report the case of a man, aged thirty-two years, who died after an acute illness of one week. There was no history of previous typhoid fever. The patient had had lues at nineteen, gradually advancing tabes at twenty-eight, and the signs of general paresis at thirty. At autopsy the findings were those of a hypostatic pneumonia, acute cerebrospinal leptomeningitis, and enlargement of the mesenteric lymph nodes; there were no lesions corresponding to a typhoid infection in the intestine. A pure culture of *Bacillus typhosus* was obtained from the meningeal pus and the large mesenteric glands, but blood cultures failed to yield the same organism. The meningeal exudate contained polynuclear leukocytes in great numbers, suggesting the hypothesis that *Bacillus typhosus* in the meninges may exert a directly pyogenic action. Should this hypothesis be upheld the indications are that the typhoid bacillus may have two separate effects: the one produced by diffusible toxin characteristically in the intestinal tract, and the other produced in the meninges either by the direct local action of the bacilli or through an endotoxin due to destruction of the bacilli. Experimentally, Southard and Richards found that *Bacillus typhosus* inflamed the meninges of guinea-pigs, the exudates showing many polynuclear leukocytes, mononuclears appearing only about seven days after inoculation. Further research is desirable to determine whether the local action of *Bacillus typhosus* in the meninges is or is not of an endotoxic type.

Palliative Treatment of Elephantiasis.—ALDO CASTELLANI (*Philippine Jour. of Science*, 1908, iii, 311) has been experimenting for some time with injections of various antiseptics, with the idea of destroying the organism which causes this disease (such drugs as methylene blue, bichloride of mercury, carbolic acid, various arsenical compounds, cacodylate of sodium, quinine, and others). All of these were of little use. Then Castellani used theosinamin on account of its power of softening various kinds of fibrous tissue. As the injections of theosinamin are very painful Castellani used "fibrolysin," which is a water-soluble combination of theosinamin with sodium salicylate, 2 c.c. corresponding to 0.2 grams of theosinamin. This dose is given daily or every other day according to the case. At the same time rest, massage, and, most important of all, proper systemic pressure by means of bandages which are necessary adjuncts. Later surgical measures can be resorted to for the removal of the redundant skin. This method the authors found of great use in a certain number of suitable cases. As yet he has found no definite explanation for the action of theosinamin. It was noted, however, that in some cases following the injection there

was a fairly well-marked, though transient, leukocytosis. It is to be noted that the treatment without a constant well-distributed pressure on the affected parts by bandaging does not cause any marked improvement, and that vice versa the pressure alone without the theosinamin injections has practically no effect in the severe chronic cases.

The Treatment of Thyroidism by a Specific Cytotoxic Serum.—JOHN ROGERS and S. P. BEEBE (*Archives of Internal Medicine*, 1908, ii, 297), in their latest report on the use of a specific serum in cases of thyroidism, review their former work on the subject go especially into the nature of the serum, and conclude that the serum has a specific effect in neutralizing the toxic action of the thyroid secretion. As a therapeutic agent it gives results which cannot in many cases be obtained by any other medical means. Not all cases presenting symptoms of thyroidism can be treated successfully with serum, because not all cases are purely hypertrophic in origin. The rapid amelioration of symptoms in acute toxic cases similar in most respects to the well-accepted instances of neutralization of toxin by antitoxin, is a weighty argument in favor of believing the symptoms to be due to the toxic agents of hyperthyroidism. The beneficial effects of combined treatment (administration of both the antiserum and the pure thyroid proteid, $\frac{1}{50}$ grain of thyroid proteid thrice daily and the injection of 5 minims of the serum every fifth day), gives the best results, and indicates a dysthyroidism as well as a hyperthyroidism as a factor in the production of symptoms.

SURGERY.

UNDER THE CHARGE OF

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Concerning Changes in the Blood after Operations.—BOLOGNESI (*Zentrbl. f. Chir.*, 1908, xxxv, 1457) says that for some time investigations have been made in the surgical clinic in Modena concerning changes in the blood following operations. In recent years he found by experiments on animals that a change occurred in the protein substance of the blood serum, in infections by the pyogenes communis. He decided to investigate whether any noteworthy changes occurred in simple operations done under careful asepsis, where the microbes were not acting and no narcosis was employed. When in small dogs various operations were performed and the blood serum of the animals, taken at various periods (three to eight days) after the operation, was treated with a 1 to 2000 solution of salicylic acid, in the proportion of 10 to 50, and this was

compared with the blood serum from a similar non-operated animal, there was always found a large quantity of precipitate (globulin?) resulting from this reaction. The quantity was less the greater the time elapsing between the operation and the taking of the blood from the animal. When the time periods were the same the quantity of precipitate was greater in the few cases in which the healing of the operation occurred by secondary intention. Bolognesi calls attention to the fact that the increase in the opsonic index of the blood found after chloroform narcosis is lacking in a simple operation without narcosis. The quantity of the precipitate found after operation corresponds to the effect on the opsonic index. In those cases in which after operation microbic infection develops, and in those in which after narcosis the opsonic index is increased, the above-mentioned precipitate is abundant.

A Communication on Nerve Surgery, with a Preliminary Report on the Anatomical Healing of Nerve Wounds.—BARDENHEUER (*Deut. Ztschr. f. Chir.*, 1908, xcvi, 24) presents a very elaborate paper on this subject, covering 200 pages. He says that the neuron theory is fully established at the present time. Nerve defects are bridged over, in all probability, chiefly through the outgrowth of fibrillæ from the central stump, rarely through connection with another center by means of anastomosis formation. The nerve fibres convey the impulses, while the ganglion cells are the functional and trophic center for the nerve fibers. For the preservation of the function of the nerve, its continuity with the ganglion cell and its nourishment by the blood are necessary. In excisions the muscles should be shortened according to the bone defect, in order that they may be so put on the stretch that they contract on the first impulse of the will and the circulation be made active. When there exists a circular constriction of the nerves and bloodvessels from non-inflammatory cicatricial tissue, conduction is impeded, from deficient elements in the ganglion cells, secondary pressure atrophy of the perifibrillar tissue, or marked and continued pressure upon the nerve fibers. Lateral pressure is dangerous only when the nerve cannot escape the pressure, *i.e.*, when the pressure works concentrically upon it, and arrests the influence of the ganglion cell. Degeneration of the peripheral portion then follows. The pressure of inflammatory material and intravaginal blood and lymph collections may produce this effect. Nerve sutures are best introduced through the nerve itself, and should be of thin catgut. In old wounds the fibrillæ adhere to each other better side to side, in which position the sutures can be more correctly placed. These at times give a better prognosis than recent wounds. For complete return of nerve conduction in the peripheral course of the nerve, three to six weeks, often a month, is necessary. In central, thick nerves, one or several years may be necessary, or it may fail entirely. Exceptionally function may return in five to twenty days, in which case there probably remained a previous anastomosis between the peripheral stump and a neighboring nerve, or between the two nerve stumps. Clinically, healing appears to occur by first intention. Histologically, it is not proved, and its demonstration appears to be impossible. Transplantation of entire nerves or by nerve flaps from an intact or slightly paralyzed nerve often gives good results. It is always best to combine it with a corresponding transplantation of the tendons, a shortening

of the paralyzed muscles by suture, and a cutting of the sound muscles and tendons. For transplantation of nerves one should take a sound nerve or a flap from a sound nerve, the function of which is not important. For this reason the hypoglossal is to be preferred to the spinal accessory, or the obturator to the crural. Hypoglossal grafting never gave better results in old wounds than in recent paralysis. The post-traumatic and postinfectious limitation of joint movements and the disturbance of nerve conduction are due not only to the adhesions of muscles and tendons to each other and shortening of the capsule on the flexor side, but also to the adhesions between tendons and nerves, which causes a constriction of the latter as well as of the arteries by the connective tissue. Under these circumstances the muscles, tendons, and nerves should be loosened, and tenotomy on the side of the injury, with myorrhaphy on the opposite side of the joint, should be done. Ischemic contractures result from interference with the return in the veins from callous constriction and a resulting neuritis. The so-called nareosis paralysis and birth palsy are due to pressure of the head upon the main vessels, accompanied by mild or severe ischemic inflammation of the muscles. In small caliber wounds of the bone and tearing of an important nerve, the nerve should be exposed in from eight to fourteen days and nerve sutures introduced. In subcutaneous nerve injuries, with moderate and rapidly disappearing paralysis, the old method of treatment with electricity and gymnastics is indicated. In old traumatic paralysis, with node formation at the site of the lesion, the electrical examination must decide the treatment after exposure of the nerve. If there is no reaction on electrical irritation on all sides of the node, then the node should be excised and the cut ends sutured together. When the reaction is present, an incision should be made through the sheath of the nerve, the blood clot removed, and the nerve and nerve sheath sutured. The very rare recurrences after ganglion excision result from anastomosis formation. After neurectomy they are due to outgrowths from the central end of the nerve or to the anastomosis of a neighboring nerve. Recurrences after neurinsarkoklesis are very rare and are the results of faults in the operation. Occasionally after excisions of the elbow, hand, and knee, there occurs, without injury of a nerve or ischemic palsy from a tourniquet, an almost complete paralysis of all the muscles. These depend, chiefly, upon the too great shortening of the bones and the relatively too great length of the muscles. The nourishment of the nerves is interfered with by the resulting deficient circulation of the blood and lymph in the nerves due to faulty tension and action of the muscles and nerves and to the surrounding inflammation. In all the nerve pressure palsies, such as occur after luxations and contusions, operation is indicated, because without it often months and years will be necessary for a cure.

Œsophageal Sarcoma.—VON HACKER (*Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1908, xc, 396) says that primary sarcoma of the œsophagus is very rare and may be regarded as a curiosity. Von Hacker reports two new cases and gives statistics of 19 cases collected from the literature. The first of his cases was a leiomyosarcoma, polypoid in shape, with its pedicle attached to the œsophageal wall, about 10 cm. below the bifurcation of the trachea. It filled up the markedly dilated œsophagus,

and hastened the death of the patient by interfering with the swallowing of food. In the second case the sarcoma was of the round and spindle cell variety, and was attached by a somewhat broader base, partly in the lower end of the pharynx and partly in the œsophagus. The first was discovered at autopsy, but the second was properly diagnosticated during life by microscopical examination of a piece excised through an œsophagoscope. This is the first case in which a positive diagnosis has been made during life. Only three cases of sarcoma of the hypopharynx were found in the literature. In both sarcoma and carcinoma of the œsophagus, except for lymphosarcoma, the greater number of cases begin between forty-one and seventy years of age. Sarcoma is relatively much more frequent in the male sex, and takes origin more frequently in the thoracic portion of the œsophagus than in the cervical. It may develop as a circumscribed, at times a polypoid tumor, or as a diffuse infiltration of the œsophageal wall. The clinical symptoms of sarcoma do not differ materially from those of carcinoma. Unfortunately, in most cases, the diagnosis has been made accidentally at autopsy, and a careful clinical history was not taken. All symptoms depending upon the stenosis of the œsophagus and upon the growth and destruction of the tumor may be very similar in both diseases. Invasion of the neighboring lymphatic glands was evident in Chapman's and one of von Hacker's cases, so that this is not distinctive of carcinoma. The examination of the œsophagus may give much information in many cases, and even a complete diagnosis. A sound may determine whether there is a circular obstruction of some other kind. It can also determine the nature of the resistance to the sound. Only by the œsophagoscope and the removal of a small piece for microscopical examination, can a positive diagnosis be made. The prognosis of many kinds of sarcoma appears to be more unfavorable than that of carcinoma. If the sarcoma is located in the cervical portion of the œsophagus and is distinctly circumscribed, operation is indicated. Baum, in a sarcoma of the hypopharynx, did a subhyoid pharyngotomy and ligated the base, which was left in place. Recovery followed, but the further course of the case is unknown. Von Hacker did a resection of the œsophagus, with the formation of an œsophagostomy. In a short time an inoperable recurrence followed. In more favorable forms of sarcoma this operation may be more successful.

Trans-Abdominal Suture of the Left Ureter upon a Ureteral Sound; Healing by First Intention.—BOARI (*Ann. d. mal. d. org. gén. urin.*, 1908, ii, 1761) says that we should bear in mind that a sound ureter differs from a pathological one. Generally the pathological ureter is adherent and immovable. Boari in doing a total abdominal hysterectomy for multiple fibromas, wounded the left ureter, to which the uterus was attached, at the termination of the operation. A No. 9 ureteral sound, conical and fenestrated, was introduced through a suitable opening in the ureter into the bladder. The other end was then passed into the central end of the ureter up to the kidney. The ends of the ureter were then united by a continuous circular suture of No. 3 catgut, without tension. The ureter was then replaced in the pelvis and covered by peritoneum and the abdominal incision closed. No trouble followed, and the woman did not complain of the presence of the sound in the

kidney or ureter. Separation of the urines from the two ureters by the Luy's apparatus was done on the third day, and it was found that the urine came only from the right ureter. The cystoscope showed that the end of the ureteral catheter in the left ureter projected about 3 cm. into the bladder, and was turned to the right, depositing its urine on that side. At the end of twelve days the sound was withdrawn with the aid of the cystoscope. The patient soon afterward went back to work, and about ten months after operation he was very well. Five months after operation a catheter was passed into the left ureter, but it detected no obstruction.

Concerning the Action of Prostatectomy upon Spermatogenesis and the Sexual Functions.—SUREDA, PEREARNAU, COMPAN, and BARTRINA (*Ann. d. mal. d. org. gén. urin.*, 1908, ii, 1766) say that recent researches on the physiology of the prostate have led some authors to consider that that organ has an internal secretion which exercises its influence upon the rest of the genital apparatus, and more especially upon spermatogenesis. The writers of this paper have studied this subject experimentally in dogs. Their work consisted of an anatomical study of the genital apparatus of the dog; an examination of the physiological condition of the spermatie secretion recovered from the vas deferens and from the epididymis; total extirpation of the prostate; observations of the sexual functions in the animals so treated; and examination of the sperm in them, before and after the injection of glycerin extract of the prostate. As a result of their studies they concluded that total prostatectomy in the dog does not suppress erections in them, nor the balanopreputial secretions; and that it is not demonstrated that the internal secretion of the prostate has a preponderating action on spermatogenesis.

A New Case of Madelung's Disease.—MARSAN (*Arch. gén. d. chir.*, 1908, ii, 472) says that Madelung has described under the name of spontaneous luxation of the wrist, a relaxation of the articulation, which is produced slowly and is aggravated little by little without any traumatism or any inflammatory lesion. Madelung has been shown to have been in error, in that there is no luxation, but a diaphyseal or epiphyseal incurvation of the radius. The disease is, therefore, a curved radius. The radio-carpal connection remains normal. Marsan reports a case in which the radial curve existed on both sides, much more marked on the left than on the right. The deformity had its origin a year before, and during the same time there developed a tubercular arthritis of the left tibiotarsal joint with fistula, which has been cured. The patient entered the hospital for a right coxalgia, which kept him in bed for six weeks. All these disturbances have followed pseudo-rheumatic articular pains, which have lasted a year and have presented their maximum intensity at the wrists. In a *resume*, Marsan says that his patient is tuberculous, and that the tuberculosis is of the articular form. The skiagram shows that the lesions occur only at the inferior diaphyso-epiphyseal junction. After the pseudorheumatismal beginning, the tubercular lesions localized themselves at the left tibio-tarsal articulation and the right hip. Then, simultaneously, there developed a double radial curve at the wrists.

Extirpation of a Popliteal Arteriovenous Aneurysm.—STICH (*Deut. Ztschr. f. Chir.*, 1908, xcv, 577) reports the following case, in which the divided vessels were united end-to-end by circular suture: A boy, aged sixteen years, received a piece of cold iron in the left thigh. He lost much blood, but the wound healed quickly, and he went to work after eight days. In a short time the left limb was much larger than normal. An elastic stocking was worn without results. A year after the injury Trendelenburg's operation for varicose veins was performed, again without improvement. About five months later he was again operated on. The swelling and the disability were much greater. Besides a very thick and elastic œdema, there was visible in the whole leg and up to the junction of the middle and upper thirds of the thigh a cord like vein, dilated to the thickness of the finger. This pulsed distinctly, especially in the region of the knee; its walls were thickened and nodular, as in varicose veins. No pulsation could be felt in the dorsalis pedis and anterior tibial arteries. Over the popliteal region a considerable bruit could be heard on auscultation. The dilated vein was freely exposed just above the knee, and the wound was deepened into the popliteal space which contained a pulsating tumor, which was shown to be a sacculated, lateral dilatation of the popliteal artery. It communicated with the vein and gave to it a strong pulsation. The vein was torn during the operation and was ligated above and below the communication, so that a 4 cm. long piece of the vein could be resected. The arterial aneurysm was so inconveniently placed on the joint side of the artery that a plastic operation for the closure of the opening in the artery could not be carried out. The opened specimen showed that a double lateral suture of the artery and of the vein would have been necessary, and a troublesome stenosis would have resulted. After the application of clamps to the artery, a 1 cm. long piece was removed, which contained the communication with the artery. The two ends of the artery were brought together by slightly bending the knee; and were united by a circular suture with much less difficulty than is frequently the case in the smaller arteries of the lower animals. Immediately after the operation the toes of the left foot were of a normal color and the sensibility well preserved. Five months after operation the patient felt tension in the limb only after long walking. Fourteen days after the operation he went back to his work as a blacksmith. There is distinct pulsation in the left dorsalis pedis and anterior tibial arteries.

An Experimental Contribution to the Question of the Collateral Circulation of the Kidney.—FLÖRCKEN (*Deut. Ztschr. f. Chir.*, 1908, xc, 591) carried out some animal experiments to show the advantages in collateral circulation of the kidney from connecting the omentum with the kidney after decapsulation. Martini, Parlavecchio, Omi, and Girgolaß came to the conclusion from their experiments that this operation produced a collateral circulation so free that it entirely or partly replaced the blood supply coming through the hilum of the kidney. Omi and Parlavecchio claimed that a better result was obtained from splitting the kidney and implanting the omentum into the cleft. Flörcken did his experiments usually in two sittings. In the first he did a transperitoneal nephrotomy and omentum implantation. In the second he

ligated the renal artery or the artery and vein, to disconnect as much as possible the kidney from the aorta or the aorta and cava. Some of the operations were done on both sides, some on one side. He concluded from his work that the double nephrotomy with implantation of the omentum in one sitting will usually not be borne by cats, the animals generally dying in a short time with uremic symptoms. After a unilateral nephrotomy with implantation of the omentum, the arterial anastomosis formed between the kidney and omentum was not sufficiently free to support the kidney after ligation of the renal vessels at the hilum. When the renal artery or artery and vein are ligated, necrosis of the kidney results. Whether the artery or both vessels were ligated the end results were the same. No efforts were made to investigate the venous collateral circulation.

THERAPEUTICS.

UNDER THE CHARGE OF

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The Curative Influence of Extracts of Leukocytes upon Infections in Animals.—Hiss (*Jour. Med. Research.*, 1908, xix, 323) in the introduction, discusses some facts and hypotheses of immunity and gives reasons to support the idea that leukocytes play an important part in the protection against infections. This protective power is most marked in those infections in which the poisoning is supposed to be due to endotoxins. In these infections there is most need for a direct action of the leukocytes upon the invading microorganisms and their poison. Ordinarily this action occurs in the body of the leukocyte and forms a part of the phenomenon of phagocytosis. Hiss assumes that the leukocytes manufacture some substance or substances—(digestive) poison-neutralizing or complementary—which prevent the destruction or injury of the leukocytes during phagocytosis. These substances exist in the individual cells and are not ordinarily given off into the blood stream. Hiss, from this hypothesis, conceived the idea that these substances might be extracted from the leukocytes and artificially introduced into infected animals or man. Such substances, if they became free from the cells by extraction might aid the leukocytes in their fight against infection by furnishing them as directly as possible with the active substances. The leukocyte, then, would be enabled to recuperate and would be better protected against destruction. This idea of immunity assumes the presence and production in the leukocytes of agents which are not normally given up to the plasma, and are for the benefit and protection of the individual cell. These agents are only of benefit to the body when the leukocytes containing them exist in sufficient numbers to intervene successfully between the invading germs

and their products and the cells requiring protection. If these substances are introduced artificially in an available form, they might neutralize poisons in the blood and thus accelerate the work of the body leukocytes. Hiss used rabbits for most of the experiments; occasionally dogs and guinea-pigs were used. He speaks of the possible variations in the protective power of the leukocytes of different animal species. The leukocytes were obtained by double pleural inoculations with aleuronat. The resulting exudate was centrifuged and the serum decanted. The cells were either directly subjected to the extracting fluid or after washing with normal saline solution. The extracts were obtained by thoroughly emulsifying the cells in distilled water and allowing them to stand for a few hours at 37.5° C., and then at ice-box temperature until used. The resulting extract is shaken up before injection since there is often considerable cell residue which may contain some of the active substances. Dog leukocytes seem to go into solution very readily, while rabbit leukocytes are not materially changed morphologically. A very brief general summary of Hiss' detailed experimental evidence only is possible, but the evidence certainly seems to justify the belief that extracts of leukocytes furnish some means of combating infections. Animals suffering from severe septicemias and poisonings following intravenous injections of such organisms as staphylococci, streptococci, pneumococci, meningococci, and typhoid bacilli showed marked resistance after the leukocyte injections, when compared with the controls. In many instances they survived injections fatal to the control animals in thirty-six hours even when the treatment was delayed for twenty-four hours. The animals treated often showed a marked fall in temperature corresponding to the injections. The beneficial effect of the extracts was often seen in a diminution of the loss in weight or a rapid return to a normal weight. Animals thus treated often seem, for a time, much sicker than the controls. This is especially true in typhoid and meningococcus infected animals, and also occurs to some extent in cases of pneumococcic infection. Hiss thinks that this result may be due to an increased bacteriolysis and the consequent liberation of endotoxins, thus suggesting the presence of complementing bodies, or of digestive substances peculiar to the leukocytes. The immediate effect on the temperature and the rapid improvement in body weight give a strong impression that the principal substance at work is an antitoxin.

Hiss' conclusions are as follows: Extracts of leukocytes from normal rabbits have a distinct modifying and curative action when given subcutaneously or intraperitoneally to rabbits, even in systemic infections which are rapidly fatal in untreated rabbits. Rabbit leukocyte extracts are also similarly useful in infections of guinea-pigs. Extracts of leukocytes from immunized animals seem, in some instances at least, to have even greater curative effects than extracts from leukocytes of normal animals. The action of the leukocyte extract may be due to an increase of the bacteriolytic action of the animal's plasma by the introduction of complement or to the action of digestive substances usually not liberated from the leukocyte, but is most likely due to poison-neutralizing or destroying bodies which act on the endotoxins. These bodies he denotes by the term *endo-antitoxin*. Hiss finally says that it does not seem unlikely that extracts of leukocytes (polymorphonuclear and

mononuclear) and possibly of the blood forming organs furnish us with means of combating infections incited by those microorganisms generally looked upon as giving rise to endotoxin poisonings and which have steadily refused to yield to the action of immune sera alone.

The Curative Influence of Extracts of Leukocytes upon Infections in Man.—HISS and ZINSSER (*Jour. Med. Research*, 1908, xix, 429) supplement the experimental work on animals with some observations upon the value of such extracts in the treatment of human disease. The extracts used were aqueous extracts of rabbit leukocytes, which were injected subcutaneously. Local reactions were slight, and lasted at most for a few hours. This treatment was carried on in twenty-four cases of epidemic cerebrospinal meningitis. Two of these cases were discharged against advice before the outcome of the disease could be foretold. Although they were apparently improved, they are not included in this report. Of the remaining 24 cases, 14 were discharged cured and 8 died. Fifteen of these 22 cases were under fifteen years of age, and of these 15, but three died, giving 80 per cent. of recoveries. Of the remaining 7 cases over fifteen years of age, 5 died. This may be due to the fact that several of these adult cases were in a moribund condition when admitted to the hospital. Some of these fatal cases in adults showed marked improvement under treatment, living twenty-seven, seven, thirty-eight, eleven, and twenty-five days after treatment was begun. They state that, of course, statistical studies of such a small number of cases is of little intrinsic value, but that their observations in the individual cases pointed very strongly to the beneficial effect of the leukocyte extract. Immediate improvement occurred after the injection of the leukocyte extract no less in some of the fatal cases than in those recovered. Such changes seemed more marked after the first injection than after later ones. There was an almost invariable improvement in those symptoms which depend upon the central nervous system, such as vomiting, delirium, stupor, and hyperesthesia. This improvement was so prompt that it seemed to exclude any anatomical changes, and, therefore, they believe these symptoms are due to the toxemia. A marked reduction in the temperature was usually caused by the injection. This reduction was often only temporary, and they believe that this is further evidence of an antitoxic action of the extract. A reduction of the leukocytosis occurred as the toxic symptoms lessened, and in some of the cases the spinal fluid became less turbid. They also treated seven cases of lobar pneumonia, and, although drawing no definite conclusions, they believe that further clinical tests may be of definite therapeutic value. In pneumonia there was an almost invariable drop in the temperature following a single injection of the extract. The antitoxic action is thus again suggested. The improvement in the subjective symptoms, the limitation of the lesions, and the increase in the number of leukocytes in some of the cases are additional factors which seem to indicate a more efficient operation of the natural agents of protection.

The Effect of Injected Leukocytes upon the Development of Tuberculous Lesions.—OPIE (*Jour. Exper. Med.*, 1908, iii, 419) says that when tubercle bacilli are injected into the pleural cavities of dogs, the

result is an almost certain fatal general tuberculosis. The process begins first in the mediastinum and rapidly extends to the lungs, liver, and kidneys. Opie found that this result could be delayed and in isolated cases cured by the intrapleural injection of a sterile purulent exudate. This sterile exudate is obtained by the intrapleural injections of turpentine in healthy dogs.

Typhoid Toxin Obtained by Means of Lecithin and its Immunizing Action.—BASSENGE (*Deut. med. Woch.*, 1908, xxix, 1257) supplements some observations previously reported. In the earlier observations Bassenge found that a 1 per cent. emulsion of lecithin in sterile distilled water had the property of dissolving typhoid bacilli. If this emulsion was introduced into the peritoneal cavity of guinea-pigs, the animals would be protected against subsequent intraperitoneal inoculation of typhoid bacilli, provided that a period of twenty-four hours had elapsed between the injections. In the present paper he confirms these results. He compared Merck's ovolecithin, brain lecithin, plant lecithin, and agfa-ovolecithin. A 1 per cent. emulsion seemed to be the maximum strength obtainable. To 20 c.c. of the lecithin emulsion, two loopfuls of a twenty-hour broth culture were added. In all of the experiments, all traces of living bacilli disappeared within twenty-four hours. Old ovolecithin seemed to have an almost instantaneous bacteriolytic action. 1 c.c. of the emulsion killed one-third of the animals, while 2 c.c. killed all. By regulating the dose of the emulsion, guinea-pigs were so immunized that they resisted twenty times the lethal dose of virulent typhoid bacilli. This result was obtained when an interval of from twenty to twenty-four hours between the injections was allowed to elapse. The control guinea-pigs died in from seven to nine hours. This immunity persisted as long as thirty-eight days. Bassenge concludes that lecithin is capable of setting typhoid toxins free in sufficient quantities to produce powerful antibodies when the emulsions are introduced for the purpose of immunization. He suggests that the lecithin emulsions may be of value in the treatment of typhoid fever in man. The lecithin may be removed from the emulsion by shaking the emulsion with chloroform and filtering through a Pukal filter.

Restriction of Fluids in Nephritis.—STRAUSS (*Berl. klin. Woch.*, 1908, xxi, 998) does not reject the opinions of Oertel and of von Noorden that large amounts of fluid increase the work of the heart in cases of cardiac insufficiency due to cardiac disease. However, he believes that other equally important factors exist in cases of cardiac insufficiency due to disease of the kidneys. He thinks that an increased amount of fluid is necessary for the removal of the poisonous substances and that their removal will more quickly lighten the work of the heart. He could not determine an increase of the blood pressure when large quantities of fluid were used. His observations on the urine and blood serum and certain animal experiments did show a diminution in the excretion of the poisonous products of metabolism when the amount of fluid was diminished. He, therefore, thinks it absolutely necessary to increase the amount of the fluids, even if an overburdening of the heart is a result. Rest in bed and digitalis should be used to combat this tendency to cardiac weakness. If the heart weakness is marked, Strauss

advocates moderate amounts of fluid given in small frequent portions at fixed intervals. Strauss also believes that anasarca in nephritis is a compensatory measure, since the fluid may dilute the retained poisons. If increased fluids are given, the anasarca will disappear in many cases. On the other hand, the anasarca may increase, and then the removal of the fluid by aspiration results in the withdrawal of both fluid and poisonous bodies. If uremic symptoms occur Strauss increases the amount of fluid. Slow, rectal irrigations are of great service (drop method of Wernitz), though he warns of the possible damage to the kidneys from the use of sodium chloride solution.

The Serum Treatment of Chronic Nephritis.—CASPER and ENGEL (*Berl. med. Woch.*, 1908, xli, 1836) give an account of eleven cases of chronic nephritis treated with serum which they obtained in the following manner: 50 to 60 c.c. of blood was withdrawn by venesection from a given case of nephritis. This blood furnished 25 to 30 c.c. of serum which, after warming to 58° C., was injected in healthy dogs. The dogs were injected once or twice a week in gradually increasing doses until eight or ten injections had been given. The dogs were then bled and the serum obtained. This serum was injected in small doses in cases of nephritis until, after repeated injections, no constitutional reaction occurred. Then normal human serum and even at times normal animal serum was injected for the purpose of supplying the complement. Their findings were as follows: (1) The treatment is harmless. (2) In some cases the amount of albumin and the number of casts in the urine remained the same; in others, they diminished and even entirely disappeared. (3) In all the cases, the general condition was benefited. (4) The œdema disappeared. They believe that the serum has no effect on the kidney tissue already diseased, but that it may prevent the extension of the process. They explain in this way the apparent absence of effect upon the amount of the albumin and number of the casts in some of the cases in which the other symptoms improved.

The Action of Arsenic on the Red Blood Corpuscles and a Theory of the Blood Defect in Pernicious Anemia.—GUNN (*Brit. Med. Jour.*, 1908, 2481, 145) draws the conclusions from his experiments that arsenious acid forms a fixed combination with red blood cells and acts as a protective agent against hemolytic agencies. His experiments were concerned with the hemolytic action of distilled water. The protective action of arsenic was perceptible when the experimental solution was as weak as one in 400,000. The ordinary maximum dose of arsenic is 0.005 gram, and if this was all absorbed, the amount of arsenic in the blood would be one in a million. However, arsenic is frequently given in larger doses in the organic combinations, and it is very slowly eliminated. Furthermore, arsenic seems to attach itself so rapidly and so firmly to the red blood cells that it is probable that the drug is largely taken up by them. Therefore, he believes that arsenic is of benefit in pernicious anemia because it prevents the destruction of the red blood cells. He also believes that arsenic protects the red blood cells from invasion by the malarial parasite, but that it does not destroy the parasite. His theory of pernicious anemia is not an entirely new one. He thinks

that the defect is not in the hemoglobin, but in the stroma of the red blood cells; that the stroma has a deficiency of lecithin and cholesterin; that the lack of rouleaux formation of the red blood cells in pernicious anemia points to a deficiency of fats; that these lipoid substances are lecithin and cholesterin; and that the poikilocytosis and irregular staining characteristics are additional reasons for assuming such a deficiency. On the basis of this theory, the beneficial effects of extracts of bone marrow may be explained, for bone marrow is rich in lecithin and cholesterin.

PEDIATRICS.

UNDER THE CHARGE OF

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Present Knowledge of Whooping-cough.—H. H. DONNELLY (*Archives of Pediatrics*, 1908, xxv, 819) writes concerning whooping-cough as follows: The mortality from whooping-cough is exceeded only by that from typhoid fever and from diphtheria, all other epidemic diseases having fewer fatalities. In 1906 there were 6324 deaths due to it, 96 per cent. occurring in children. Of every 37 deaths occurring in children in 1906, one was due to whooping-cough. It is chiefly a disease of early childhood; premature infants may contract it, 20 per cent. of the cases occurring in infants less than a year old, while 66 per cent. occur in children under five. The ratio of girls and boys is 6 to 5. It occurs more frequently during raw and inclement weather. An organism indistinguishable from the influenza bacillus has been isolated from the sputum by a number of observers. The serum of whooping-cough cases produces marked agglutination of these bacilli in dilutions of 1 to 200 to 500. Deaths in whooping-cough are usually due to its complications (bronchopneumonia, tuberculosis, emphysema, cardiac disease, cerebral hemorrhage). Tracheobronchial catarrh is constant in these cases. The contagion persists throughout its entire course, and is especially marked in its early stage. The contagion is usually direct. The period of incubation is unknown. The clinical symptoms are readily recognized, when the disease is well developed; during the early stage the child complains of lassitude, headache, disturbed sleep, catarrh of the upper air passages, cough; slight fever may be present. Blood examination shows an increased leukocyte count with lymphocytosis. Puffiness and bloating of the face are marked between paroxysms; they are due to venous and lymphatic stasis. A few rales before the paroxysm, followed by signs of emphysema afterward are the only chest signs present in an uncomplicated case. There is an increase of uric acid secretion. The average duration is from eight to twelve weeks. The complications are chiefly due to the mechanical effects of the cough, the extent of the infection, and the lowering of the general tone rendering other infections possible. The treatment in-

cludes attention to hygiene, ventilation, clothing, and diet. A rational fresh air treatment should be carried out; an abdominal belt made of linen relieves vomiting and lessens the paroxysm. Local antiseptics should be used; of drugs, quinine and antipyrine have more advocates than others.

A New Treatment for Old Tuberculous Sinuses.—J. RIDLON and W. BLANCHARD (*Amer. Jour. Orth. Surg.*, 1908, vi, 13) treated 26 children having old tuberculous sinuses with Beck's bismuth-vaselin paste. A paste made up of 2 parts of vaselin to 1 part of bismuth was injected and a skiagram taken showing the ramifications of the sinuses. This injection was usually expelled within twenty-four hours. Then a paste made up of 6 parts of bismuth subnitrate, 1 part of white wax, 1 part of soft paraffin, and 12 parts of vaselin (mixed while boiling) was injected into the fistulous opening until it would hold no more without painful distention; all or part of it was usually retained. The paste must be at blood heat at the time of injection. The amount discharged into the dressing was re-injected every two to three days. Favorable cases retain the bismuth, the opening healing over in from one to three weeks. In cases with extensive bone destruction several sinuses are usually injected from two to three times weekly, the pus then escaping from the others. If the pus disappears within a few weeks, assurance may be given that months of persistent treatment will cure the sinuses. If the pockets are so situated that the bismuth cannot be forced in to displace the pus, the results will always be negative. Ridlon and Blanchard ascribe the curative action to the bismuth acting in a mechanical way. The pus is forced out by the plug, which then so completely fills the sinus, as to prevent the ingress of air-carrying germs; lastly it compresses the unhealthy granulating surfaces, a normal healing process naturally resulting. Of the 26 cases, 6 were cured with a single injection, 7 with from two to fifteen injections, 7 were improved, 1 unchanged, and 5 are still under treatment.

A Contribution to the Study of Tuberculin in Orthopedic Practice.—C. OGILVY (*Amer. Jour. Orth. Surg.*, 1908, vi, 35) employed tuberculin according to Calmette's ophthalmotuberculin test in 40 children from the standpoint of diagnosis; in 30 the reaction was positive, in 10 negative. Of the latter, 9 were non-tuberculous. The negative reaction in cases known to be tuberculous has been claimed by some to be due to a condition of low resistance—low opsonic index as occurs in the negative phase; this is probably the case in the tenth instance, which was one of known tuberculous hip-joint disease. Six patients were treated with injections of tuberculin, and the following conclusions were drawn from the observations by Ogilvy: By means of the opsonic index we have learned the importance of small doses of tuberculin, and the time at which they should be administered. But this having been learned, it is by no means necessary, nor is it practical, to follow up the treatment with control indices. For the diagnosis of tuberculous bone and joint disease the opsonic index is of little practical value. Tuberculin in small doses at proper intervals is of undoubted value in the treatment of selected cases of tuberculous bone and joint infections. The rise of the opsonic index is accompanied by an improvement in the local and

general conditions of the patient, if no secondary infection exists. While there are discharging sinuses and mixed infections, the opsonic index may be raised by the use of tuberculin without an accompanying improvement of the general or local condition. The opsonic index will prove of value in determining the advisability of discontinuing mechanical treatment. It is also of value in determining the prognosis in tuberculous bone and joint disease.

Tumors of the Breast in Childhood.—J. H. JOPSON, J. SPEESE, and C. Y. WHITE (*Annals of Surgery*, 1908, xlviii, 662) report 2 cases of benign mammary tumors in children, give a review of the literature on the subject of mammary tumors in childhood, and formulate the following conclusions from their studies of the subject: Tumors of the breast, while rare in childhood, occur in both sexes and at all ages. The benign tumors are more frequently encountered in the mammary gland in early life than the malignant tumors. The fibro-epithelial growths are the most numerous group of the benign tumors, and next to these in point of frequency come the angiomas. Sarcoma may occur in children in the mammary gland, but it is a rare tumor. The breast enjoys almost complete immunity to carcinoma before the age of puberty. Girls are affected more frequently than boys, but the disparity in numbers is immensely less than in adults. The angiomas are commonly congenital, or first appear in infancy. The fibro-adenomas tend to develop more frequently as the child approaches puberty. Some of the smaller benign tumors occasion no inconvenience. Others are associated with symptoms of pain, tenderness, and inconvenience or discomfort from excessive weight or size. Sarcomas present the symptoms common to that type of tumor. Operation is usually indicated in the benign and always in the malignant varieties. In small benign tumors, or those involving only limited areas, conservative plastic operations with preservation of the breast and nipple are indicated. In a goodly number, however, the breast must be sacrificed. The axilla should be cleaned if it contains enlarged glands. The results of operation are good.

Purpuric Hemorrhages following a Blow upon the Kidney Region.—E. LENOBLE (*Arch. des mal. du cœur*, etc., 1908, i, 475) relates the case of a boy, aged sixteen years, who had fallen a distance of 2 meters during play, striking his back. Pain over the kidneys developed, but not sufficient to force him to stay in bed until the tenth day, when he began to vomit and developed an intense diarrhœa. He bled from the nose and gums, and numerous petechiæ appeared over arms and legs. On the fifteenth day he voided bloody urine. The flanks were dull, the abdomen distended and tympanitic. Rectal examination showed a mass behind the bladder. Four weeks later a second purpuric eruption appeared all over the body. The urine was still bloody, and an ascitic accumulation was noted within the abdominal cavity. The red corpuscles were reduced to 3,200,000; there were 334,000 hemoblasts; the blood did not clot nearly as readily as normally, and numerous myelocytes were present. Complete recovery ultimately resulted.

OBSTETRICS.

UNDER THE CHARGE OF

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The Significance of Hemolytic Streptococci in Puerperal Infection.—HEYNEMANN (*Archiv f. Gyn.*, 1908, lxxxvi, Heft 1) reports his investigations regarding the significance of hemolytic streptococci in cases of puerperal infection. He examined the blood and lochial discharge from 125 puerperal patients who had fever. Among these were 22 in whom hemolytic streptococci were found; 4 died. In these patients the streptococci were found in the blood in abundance, and large doses of antistreptococcic serum were of no avail. In 2 patients thrombophlebitis of the pelvic veins was present, accompanied by severe chills. In both these cases the bacteria were obtained in pure culture from the uterine secretion. In one case Friedländer's encapsulated bacillus was found, and in another case *Staphylococcus aureus*. Both of these patients recovered. Among the 18 in whom hemolytic streptococci were found in the lochial secretion but not in the blood, there was no death, although the patients were severely ill. These cases were characterized by sudden rise of temperature to 104°F., with pulse of 126 to 140. This temperature subsided after a few days and these patients had no anemia, and the heart was practically normal throughout the illness. They were treated by absolute rest in bed, an ice bag placed over the lower abdomen, and the administration of ergotin. Various observers have found streptococci frequently in the lochial secretion from the uterus and vagina, and the presence of these germs in the genital tract is not an indication of fatal infection. In cases in which they are present there is a greater tendency to thrombophlebitis and parametritis. In some of these patients the colon bacillus was also found. In 2 of these cases the children became infected, and pure cultures of the streptococci were found in the stump of the umbilical cord. One of these mothers had a leg ulcer, which suppurated, and the other had a parametritic abscess. It is important to recognize the presence of hemolytic streptococci in puerperal infection, because it makes the diagnosis of infection certain. It also gives a reliable ground for prognosis, as the presence of these germs in the blood indicates that the patient is fatally ill. As regards treatment, one must abstain from disturbance by local treatment in these patients, lest absorption into the blood current be increased. The germs may be obtained from the genital tract by placing the patient upon her back in bed, separating the labia, and obtaining the lochial secretion by a sterile platinum loop, or sterile cotton, from the anterior portion of the vulva and vagina. The blood agar culture material is then infected with this secretion by stroking. In from seven to eight hours colonies of bacteria are visible, and in from nine to ten hours the growth is clearly recognizable. It is well to wait for ten to twelve hours after the cultures are started before examining the culture media to recognize the different forms of bacteria.

In six and one-half hours after infection chains of hemolytic streptococci can be seen. Clinical histories of 30 cases, with bacteriological examinations, are appended.

Spontaneous Labor in Contracted Pelves.—LEISEWITZ (*Archiv f. Gyn.*, 1908, lxxxvi, Heft 1) contributes from the Dresden clinic an interesting paper comparing the results of spontaneous birth in contracted pelves with those of various forms of pelvic delivery. He considers the pelvis as somewhat contracted in which the internal true conjugate is 10 cm., and the external from 18 to 18.5 cm. In 15,338 labors there were 6865 contracted pelves, 44.6 per cent. In some of these cases abortion or placenta prævia, or an abnormally small child, made the contracted pelvis of no importance as a factor in delivery. Among primiparæ 86.9 per cent. had spontaneous births; among multiparæ 81.1 per cent., making a general average for multiparæ and primiparæ of 84.1 per cent. of spontaneous births in contracted pelves. The percentage of labors requiring operation, in both multiparæ and primiparæ, was 18.8. When the morbidity and mortality of spontaneous and operative deliveries are contrasted, it is found that in spontaneous births there is a morbidity of 11.1 per cent. and a mortality of 0.3 per cent. in primiparæ, while from operation, morbidity was 20.3 per cent. and mortality 2.9 per cent. In multiparæ morbidity was 6.6 per cent., mortality 0.3 per cent. in spontaneous births; with operation, morbidity was 13.5 per cent., mortality 1.4 per cent. In the case of the children the morbidity and mortality were greatly increased by necessity for operation; thus, in spontaneous births mortality and morbidity was less than 2 per cent. in multiparæ and in primiparæ, while in operative cases it rose to from 21 to 22 per cent. The highest mortality and morbidity for mothers and children were in the flat rachitic pelvis, then in the commonly contracted flat rachitic, then in the flat pelvis, and lowest in the symmetrically contracted pelvis. So far as the choice of operation went, perforation was performed in 9.7 per cent. in primiparæ, 22.6 per cent. in multiparæ. Version and extraction gave a mortality of 23.5 per cent. for the children, and a mortality of 1.1 per cent. for the mothers, with a morbidity of 6.4 per cent. This method of treatment, so long a favorite one in Continental clinics, is infinitely more dangerous for the children than other and more recent operations. In induced labor the maternal mortality was 1.1 per cent., mortality for the children 29.4 per cent. In calling attention to the low mortality of spontaneous births, the statement is made that in clinics spontaneous births should not be despaired of for from twenty-four to thirty hours after the beginning of labor. In private practice the maternal mortality of perforation is a very high one, whose statistics are difficult to obtain. As regards hebostomy and Cesarean section, they are successful in proportion as patients are early seen and promptly transported to the hospital. In view of the frequency of spontaneous birth in contracted pelves, and its low mortality and morbidity, every effort should be made to bring it about, especially in cases which must be delivered in private houses.

Thrombosis and Early Getting-up in the Puerperal Period.—FROMME (*Zentrbl. f. Gyn.*, 1909, No. 1) believes that cases of thrombosis after operation and labor are more the result of infection than of early get-

ting up. He cites the case of a primipara, who during labor had ten vaginal examinations, made with gloved hands by midwives, assistants, and students. The patient was allowed to get up for one hour the day following her confinement; fever developed, and the patient died ten days after labor, with symptoms of pulmonary embolism. At autopsy an embolus was found in the pulmonary vessel, with thrombosis of the left spermatic vein and the veins of the left parametrium. In these thrombi streptococci were found; cultures were negative. Fromme believes that early getting up after confinement may dislodge thrombi which otherwise would become sterile and do no harm. During the last six years in the Halle Clinic, in 6600 cases of labor, no case of puerperal embolism has been observed.

HOFMEIER (*ibid.*) has examined the records of 10,000 puerperal women, finding 12 cases of thrombosis; 9 of these had severe complicated labors, followed by fever. In 3 cases the thrombosis was slight, and the puerperal period without fever. One of these was popliteal thrombosis, another epigastric; another developed in the varices in the lower portion of the thigh. Embolism did not occur, nor fatal result, in any of these cases of thrombosis. The conclusion is drawn that the method so long employed of giving patients rest in bed after labor, while it may not always prevent thrombosis, does, in the majority of cases, prevent embolism.

Cesarean Section with Twins and Placenta Prævia.—JARDINE (*Jour. Obst. and Gyn. Brit. Empire*, December, 1908) reports the case of a primipara with a generally contracted and flattened pelvis, on whom Cesarean section was successfully done in 1907. About two years afterward she was again admitted to the hospital with twin pregnancy, within two weeks of full time. Upon vaginal examination the edge of the placenta could be felt, but the patient had lost no blood nor was bleeding present. In view of the pelvic contraction, the twin pregnancy, and the situation of the placenta, she was delivered by Cesarean section. Incision was made in the line of the first, and the membranes, although ruptured previously, were tough and were torn through from above with some difficulty. The children weighed five and one-quarter pounds each, the placenta weighing one and one-quarter pounds. The operation proceeded without hemorrhage, mother and children making normal recoveries. The lochial discharge was a little more profuse than normal for the first few hours after delivery.

The Disinfection of the Hands with Acetone Alcohol.—OERI (*Ztschr. f. Geb. u. Gyn.*, 1908, lxiii, Heft 3) has experimented with von Herff's method of disinfecting the hands with acetone alcohol in the clinic at Basle. It is thought that the combination of acetone enables the mixture to be used on all portions of the body, and attacks the fatty tissue and disinfects it more thoroughly than alcohol alone. The use of the nail brush may be omitted, which is a great advantage. The hands are more thoroughly sterilized and in a shorter space of time than by other methods. A longer disinfection is obtained by this method. The use of soda solution for ten minutes increases the efficiency of the method somewhat. A prolonged operation without gloves does not especially increase the number of germs present. As the method is a simple one, it is especially adapted for the use of nurses and midwives. In the

clinic the alcohol employed was 95 per cent., and the proportion of acetone, after some experiment, was fixed at 10 per cent. The most efficient combination, however, seemed to be that of 50 per cent. alcohol and 50 per cent. acetone. Preliminary cleansing with soap, water, and brush was omitted. The action of the mixture on the hands seemed to harden the skin, and the hands were rubbed with sterile flannel dipped in the solution, when the redness and irritation seemed to disappear. Four minutes were occupied in disinfection. This method did not seem to irritate the skin, and one of the staff, who suffered from eczema, excited by other methods of disinfection, was much improved by this method. Bacteriological experiments showed the method to be efficient.

In direct contrast to this, in the same clinic, is Pfisterer's paper (*Ztschr. f. Geb. u. Gyn.*, 1908, lxiii, Heft 3), in which alcohol alone was used as a disinfectant. This showed that alcohol was efficient for a short time only, for operations not exceeding five minutes in length.

The Opsonic Index in Puerperal Infection.—HEYNEMANN and BARTH (*Ztschr. f. Geb. u. Gyn.*, 1908, lxiii, Heft 2) publish the results of studies of the opsonic index in various forms of puerperal infection. They find the opsonic index of the serum of puerperal patients free from fever, does not act upon the hemolytic streptococci in the proportion given by Wright, namely, 0.8 to 1.2; in proportions of 0.7 to 1.3 an effect is noticed which has to be explained in part through previous infection with streptococci. A normal streptococcus relation in a puerperal patient having fever does not render impossible the former infection; the variation in this relation would suggest it, but not conclusively. The value of diagnosis by this method is then limited and applicable to a few cases only. So far as prognosis is concerned, the estimation of the opsonic index is of no value. In some cases of parametritis, with local and long-continued infection, this method may be of value as indicating the success of the treatment. The same facts are practically true in cases of staphylococcal infection.

GYNECOLOGY.

UNDER THE CHARGE OF

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Primary Cancer of the Body of the Uterus.—BALLARD (*Surg., Gyn., and Obst.*, 1908, vii, 460) reports a case of primary cancer of the uterus in which rupture had occurred. His conclusions in the case are as follows: (1) That an early diagnosis was not made from any symptom coming from the malignant area, but rather from the sudden hemorrhage through the perforation is clearly apparent; (2) that metastasis does not occur so frequently from the carcinoma of the fundus uteri as from the cervix is markedly noticeable; (3) that malignant growths of the

body of the uterus are of much slower growth and have much less pronounced symptoms than those of the cervix is certainly proved by the cases reported; (4) that the diagnosis of early malignancy in the fundus uteri may be prevented because of the want of symptoms is evident; (5) that having made an early diagnosis we can, by complete extirpation of the uterus and adnexa, promise a very favorable prognosis.

Immediate vs. Deferred Operation for Intra-abdominal Hemorrhage due to Tubal Pregnancy.—KRUG (*Surg., Gyn., and Obst.*, 1908, vii, 473), for the purpose of discussing the above question, divides all cases of ectopic pregnancy into five principal classes: (1) Unruptured. (2) Ruptured, in which the symptoms of shock and hemorrhage are slight. (3) Ruptured, in which trauma superinduces acute hemorrhage and in which the ectopic gestation is only a contributive condition. (4) Ruptured, in which the symptoms of shock and hemorrhage are grave. (5) Ruptured: ambulance cases brought to hospitals. In the first and second divisions Krug advocates prompt laparotomy. In the third class, such as those subjected to curettage for a supposed incomplete abortion and by traction on the cervix fresh internal hemorrhage is caused, Krug advises immediate laparotomy. In the fourth class he advises careful observation watching the temperature and counting the pulse every fifteen minutes. If general improvement occurs, delay operation until the patient can better withstand a laparotomy. In the fifth class the hemorrhage has usually ceased when the patient is admitted to the hospital, and expectant treatment for one to four days and then the performance of abdominal section is advised. Krug never uses intravenous infusion of salt solution until near the close of the operation. During the past four years he has operated on nearly 100 cases of ruptured tubal pregnancy with 2 deaths. One of these was from ether pneumonia and one from sepsis existing prior to admission.

Ovarian Pregnancy Co-existing with Intra-uterine Pregnancy.—KERR (*Jour. Obst. and Gyn., Brit. Empire*, 1908, xiv, 149) adds another to the very few reported cases of ovarian pregnancy. The ovary containing the ovarian pregnancy was removed by operation. The embryo was at a stage closely corresponding to one described by Graf. v. Spec. It was so much injured, however, that reconstruction was not possible, and the sections were exhibited to demonstrate the nature of embedding in the ovary, the ovum being the youngest yet recorded in that position. There was a large corpus luteum, the contour of which was intact, except at one point where there was young organizing connective tissue forming a continuous strand reaching from the centre of the corpus luteum to the margin of the implantation cavity. The cavity has been excavated in the ovarian stroma, and its walls are formed, in part, of connective tissue in a state of coagulation necrosis, but to a greater extent by fibrin and blood clot. The surface of the ovary has been ruptured, and the ovum was evidently in the process of extrusion. There were absolutely no signs of any formation akin to decidua, and the more actively destructive phases demonstrated in the first specimen had obviously persisted until a considerable part of the ovary had been destroyed. The ovum lay more or less free in the implantation cavity, the villi were irregular, and many were overtaken by degenerative

changes, but they contained bloodvessels and showed precisely the same coverings as a uterine ovum at the same stage of development. The sections prove: (1) That the ovum can be embedded in the ovarian stroma outside the Graafian follicle. (2) That it embeds itself just as does the ovum in the uterus in connective tissue rich in bloodvessels. (3) As has already been shown by C. V. Tussenbroeck and others, the uterine epithelium is not necessary for plasmodial formation; as this ovum lies in the ovarian stroma neither can the plasodium be derived from the follicular epithelium. The two cases combined once again demonstrate the nature of implantation. The process involved is essentially a destructive one; the primary necessity for the ovum is a nidus of connective tissue rich in bloodvessels. Formation of decidua is not essential; it is a defensive reaction against the destructive activities of the trophoblast, which it limits and controls.

Pressure Conditions within the Abdomen.—SMITH (*Amer. Jour. Obst.*, 1908, lviii, 242), who has conducted experiments to increase our knowledge of pressure conditions within the abdomen, concludes: (1) Atmosphere pressure within and without the abdomen is almost exactly balanced, any variations at any point being caused by factors to be enumerated. There is no special universal positive pressure which has so frequently been assumed. Physiological increase or decrease of volume is attended by insignificant or no changes in pressure—the balance is practically maintained. A marked increase of volume from pathological conditions often takes place without disturbing the balance; this varies in different subjects. (2) Hydrostatic pressure at any point within the abdomen varies with the position of the body and the depth of the superimposed organs. (3) Negative pressure at uppermost points is possible under certain conditions where the walls of such uppermost points are rigid. In the upper abdomen in the upright position a negative pressure may exist, which has more or less to do with the support of the viscera. (4) Respiration causes small waves of pressure. (5) Coughing, sneezing, defecation, labor, and many movements of the body cause a very marked increase of intra-abdominal pressure by contraction of the muscles of the abdominal walls. Such pressure is transmitted in all directions and without diminution to every part of the contents and interior of the abdomen.

OTOLOGY.

UNDER THE CHARGE OF

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The Relation of Chronic Progressive Labyrinthine Deafness to Ménière's Disease.—ALEXANDER and MANASSE (*Ztschr. f. Ohrenheilk.*, 1908, lv, p. 183). Under the heading, Ménière's disease, are commonly

included certain labyrinthine symptoms, when they occur suddenly and are of an apoplectiform character, and these are found, according to the observations of Alexander and Manasse, in the greater majority in cases in which there has been a disease of the ear of long standing evidencing itself in chronic progressive labyrinthine deafness. In this paper Alexander and Manasse cite eleven cases of patients who for several years had exhibited, on one or both sides, evidences of this chronic impairment of hearing of an advanced type, and who suddenly became the subjects of the typical Menière's complex of symptoms, increased tinnitus, dizziness, nausea, vomiting, and increased impairment of hearing, the attacks with this sequence of symptoms being subsequently repeated. In some of the cases there were marked changes in the middle ear, considerable retraction of the drumhead, and calcareous deposits, but in all cases the symptoms, as determined especially by the hearing tests, pointed to the labyrinth as having been implicated in the progressive impairment of hearing. The labyrinthine changes in these cases, as observed by Alexander, Bruehl, and Manasse, included atrophic degenerative changes in the nervous elements and new connective-tissue formations. In addition to these commonly observed changes Manasse found, in two cases, multiple hemorrhages in the course of the auditory nerve and in the labyrinth, and in one case numerous hemorrhages in the ligamentum spirale, a lesser number in the modiolus, an extensive number in the macula sacculæ, and congeries of hemorrhages in the nerve itself. The Menière sequence of symptoms in this case was undoubtedly the result of these numerous hemorrhages; more exact evidence was furnished by a second case of chronic progressive labyrinthine deafness, which had been under clinical observation and which came to autopsy but a few days after an attack characterized by Menière's complex.

From these observations Alexander and Manasse draw the following conclusions: (1) That in cases of nervous deafness attacks demonstrating Menière's complex of symptoms are comparatively common; (2) that in cases of degenerative labyrinth atrophy multiple hemorrhages in the labyrinth and in the auditory nerve are to be expected; and (3) that the access of these attacks is referable to the hemorrhages in question.

HYGIENE AND PUBLIC HEALTH.

UNDER THE CHARGE OF

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Endotoxins.—At the July, 1908, meeting of the German Society of Microbiology (*Centralblt. f. Bak.*, October 27, 1908) the so-called endotoxins and their relation to the true toxins were discussed, and the discussion developed considerable difference of opinion. Pfeiffer led the discussion and quite properly claimed that his research on the cholera poison was the first work that quite clearly indicates that the bacterial

cellular substance contains a poison. Pfeiffer holds that the poison is firmly bound in the bacterial cell; it cannot be extracted except by deep-reaching chemical changes; it is not a secretion in any proper sense, and it is not set free nor can it injuriously affect the animal until the bacterium not only ceases to live, but is broken down, and its component parts pass into the solution. Pfeiffer states that he has never held that the endotoxins may not possess antigenic properties; but he has stated and still holds that in cholera and typhoid fever there is no evidence that an antitoxin is or can be produced. There may be found antibodies, but not in conformity with the theory of Ehrlich. He has not gone so far as some of his students have, as to assert that anti-endotoxins may not be found, but if ever found they will most probably be quite different from the antitoxins already known, such as those of diphtheria and tetanus. There is a distinct difference between anti-infectious and antitoxic sera, and the therapy of the future will probably be more greatly benefited by improvements in the former than by discoveries of the latter. The dead cells of cholera bacilli are distinctly poisonous to man and experimental animals. This has been demonstrated beyond any question, notwithstanding its early denial by Gruber. The same is true of the cellular substance of the typhoid bacillus, and Friedberger has shown that the intravenous injection of only one-twenty-fifth of a milligram of the dead typhoid bacillus may cause most marked and prolonged toxic symptoms. However, the toxicity of the pathogenic bacteria is widely variable. Along with exquisitely toxic species are those that are relatively harmless; moreover, the susceptibility of animals to the endotoxins is also widely variable. Ransom and Metchnikoff found a poisonous body in old bouillon cultures of the cholera bacillus, and attempted to produce an antitoxin with it, but it is worthy of note that this poison does not appear in recognizable quantity until the culture has grown old and the bacilli undergo autolytic changes. Indeed, as Hahn has shown, fresh cultures of this bacillus are free from poison, consequently there seems to be no justification in holding or even suspecting that the cholera poison is a secretion. So long as the cell is growing and multiplying it forms no poison. The poison is not a secretion; it is a product of the dissolution of the cell. It is true that some atypical cholera strains, such as that of El Tor, produce an extracellular poison, but this is not true of typical cholera bacilli. Such a poison is not found either in tube cultures or in the peritoneal fluid of animals dead from the effects of these bacteria. Moreover, the poison that does result from the autolysis of old cultures varies in some properties at least, according to the stage in the decay and disintegration of the cells when it is examined. This is easily understood since it is more than probable that the primary products of autolysis undergo farther cleavage as time progresses. There have been several reports of the finding of soluble poisons in typhoid cultures, but in all of these the culture is old, and the poison is supposed to result from autolysis; besides such poisons are not highly active and by no means comparable with the toxin elaborated by the diphtheria bacillus. The same is true of the dysentery bacillus; even one-twentieth of a milligram of the dead cellular substance may kill a rabbit when injected intravenously, while Conradi found that 15 c.c. of the filtrate from cultures of from seven to thirty days old were without effect. It is true that Todd and Rosenthal obtained from filtered cultures of the dysentery bacillus,

from twenty to thirty days old, a filtrate 0.1 c.c. of which killed rabbits when injected intravenously, but it should be remembered that growth stopped in these cultures at five days, at which time the filtrate showed no toxic action; therefore, the most reasonable conclusion is that the poison found in solution in such cultures from fifteen to twenty-five days later results from cellular autolysis. If the poison were a secretion it should appear while the bacteria are still alive and multiplying. It is hardly conceivable that dead or even inactive bacteria pour out secretions. Secretions are products of life processes. It is possible that some varieties of the dysentery bacillus elaborate soluble poisons, but these are the exceptions and not the rule; besides, the toxicity of the cell substance is always many times that of the filtered culture. Cholera, typhoid fever, and dysentery are infections and not intoxications.

Pfeiffer describes MacFayden's method of extracting the endotoxins, and quite properly rejects it as costly, uncertain, and by no means convincing. It will be remembered that MacFayden froze his typhoid bacilli at the temperature of liquid air, powdered them, and then extracted with 0.1 potassium hydroxide. The freezing probably gave him a fine powder and the dilute alkali extracted small quantities of the endotoxin. He might have omitted his costly freezing, and used a stronger alkali in proper menstruum, and then he would have secured a much more active poison. Boreger takes the bacteria from agar slants and suspends them in physiological salt solution. This is evaporated to dryness and finely rubbed in agate mortars, then this powder is diluted with water until the strength of physiological salt solution is again reached, then it is centrifuged, when it is found that the supernatant fluid is poisonous. By this means a fine suspension of the cellular substance is obtained, nothing more. Pfeiffer states that he has tested the so-called antitoxic cholera and typhoid sera of Kraus, but with only negative results. He concludes his part in this discussion as follows: (1) Endotoxins really exist and are important factors in the infections. The possibility of preparing anti-endotoxic sera is still an open question. (2) The soluble poisons found in certain old cultures are autolytic products and may have no concern in the disease processes. (3) There are other methods of obtaining poisonous bodies from bacterial cells. (4) Together with the endotoxins and their derivatives there are produced by some bacteria true toxins that are secretory products.

Kraus, Pfeiffer's most prominent opponent, replied and in concluding made the following statement: He believes that the cholera, typhoid, dysentery, pest, and meningitis organisms contain specific toxins which have antigenic properties, producing their specific antitoxins by which they are neutralized. These poisons can be obtained not only by extracting the bacterial cellular substance, but in the filtrates of bouillon cultures. Whether these poisons are secretions, as some authorities hold, or pass into solution from the disintegration of the cells, has not been determined, and should not be brought into the discussion because it is a matter of secondary importance, and its solution would not add much of value to what we know. The important thing is that the intracellular and the soluble poison are identical and produce antibodies and are neutralized by antitoxins. It is desirable that it be ascertained what the relation is between these toxins and the aggressins of Bail and the phenomena of anaphylaxis. Kraus thinks that the aggressins are poison-

ous and that the toxins are not concerned in the phenomena of anaphylaxis, both of which opinions are probably wrong.

Kolle and his students, one of whom, Heller, participated in the discussion, believe that the soluble and the intracellular toxin are different bodies, and this seems to be best warranted by the facts. Heller using *Bacillus dysenteriae* of Shiga produced the specific symptoms and characteristic lesions of the disease in rabbits and mice by, (1) the filtrate from twenty-day cultures, (2) filtered washings from living cultures, and (3) the dead washed bacillus. Then he attempted to obtain antitoxic sera with each of those and succeeded, but he found the antitoxic serum obtained with the dead washed bacillus was much less active than the others, and moreover, that the other sera protected against the extract and filtrate better than against the dead bacillus. He concludes from this that the toxin and endotoxin are not the same, but that the dead washed bacillus still contains some of the true toxin.

It may be seen from the foregoing abstract that our German friends are divided into at least three groups in their ideas concerning the relation between the true or soluble toxins and the so-called endotoxins. Pfeiffer holds that some bacteria, among which are those of cholera, typhoid fever, and dysentery, elaborate no true toxins, but that their poisons are intracellular and when found in solution they result from cellular autolysis or disintegration, and that active anti-endotoxic sera have not been produced. Kraus holds that these same pathogenic bacteria, like those of diphtheria and tetanus, do elaborate true toxins with which specific antitoxic sera may be prepared, and he does not care whether we believe that these toxins are secretions of the living cells or result from the breaking up of the cellular substance. Kolle and his students hold that these same bacteria have both true toxins and endotoxins, and that antibodies to the former are not produced by nor do they neutralize the latter. All, however, seem to agree that the poison elaborated by each species of bacillus is specific. [The writer of this review holds that the true or soluble toxins, like those of diphtheria, tetanus, botulism, etc., are specific and produce specific antitoxic sera, but that the endotoxins of the cholera, typhoid, and tubercle bacilli are not specific, but that every true protein, whether it be bacterial, vegetable, or animal, contains a poisonous group which in its effects on animals is the same. The presence of a special protein in the blood of an animal develops a specific enzyme which splits up that special protein and liberates the poisonous group to the detriment of the health and possibly at the cost of the life of the host.—V. C. V.]

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ORIGINAL ARTICLES.

SURGICAL ANEMIA AND RESUSCITATION.¹

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It so happened that at the time I was invited to deliver this lecture, my research associate, Dr. D. H. Dolley, and I had reached a point in the investigation of one phase of the subject of surgical anemia, at which, in conjunction with my own previous experimental and clinical work, tentative generalizations seemed warranted. The following statements include, for the most part, generalizations of experimental and clinical observations. I have drawn heavily on the histological work of Dr. Dolley. It is not possible on this occasion to refer to the many valuable contributions he has made. From the literature I have drawn liberally upon the work of D'Halluin, Hill, Stewart, and his associates, as well as upon that of Sarbo, Marinesco, and Mott. A detailed publication of the data upon which the generalizations are based is contemplated later.

In the vegetable and in the animal kingdom functional activity and growth require an almost constant supply of food. Impairment or loss of this constant supply is followed by impairment or loss of function or by death. Increased or diminished food supply affects growth and function in infinite ways. Owing to environment and ultimate design, species respond differently to the loss of food. Neither individuals as a whole, nor their various parts, respond equally to a diminished or a complete loss of food. The histological elements of a given organ endure the various degrees of impairment

¹ The Mütter Lecture of the College of Physicians of Philadelphia, delivered December 11, 1908.
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or loss of function differently. Death of an animal, therefore, falls unevenly upon its various tissues and organs. Undoubtedly, post-mortem examinations and burials are made while some of the tissues of the body are still living. The vital spark may smoulder or it may be extinguished. Death may be definitive or relative. Definitive death is a vital and final resolution and is irremediable. Relative death is a state of suspended animation.

Suspended animation is susceptible of re-animation or resuscitation. Suspended animation, as understood for our present purpose, is produced by a loss of food supply, and re-animation or resuscitation may be accomplished only by a supply of the required nourishment. Whether the needed chemical elements are supplied in gaseous form as oxygen, or in chemical combination as proteids, they all constitute food. The loss of this complex food supply will, for our present purpose, be designated anemia, and the anemia most frequently met in surgical practice I will designate surgical anemia.

Surgical anemia may be due to absolute loss of blood volume (hemorrhage); to segregation of the blood in the vascular system by disturbance of the vascular mechanism, as in shock or collapse; to local interruption of the circulation by mechanical means, such as thrombosis or embolism, strangulations, torsions, tourniquet, bandages, apparatus, pressure, etc. Whether considered with reference to the entire body or to a part, the result of a given anemia, whether partial or complete, is dependent upon the susceptibility or the resistance of the affected part to anemia.

It is not my purpose at this time to consider hemorrhage, shock, collapse, and the various mechanical agencies alluded to, any further than as to their role as a cause of surgical anemia. Disregarding, then, the mechanism of the cause of anemia, I will in a general way, as they relate to the practice of surgery, consider the phenomena of anemia and its treatment, namely, resuscitation.

To approach this subject, we first need to know the relative endurance of the various tissues and organs to anemia, hence their resuscitability. Turning to this point of our inquiry, we are at once confronted by many difficulties, the principal being the various degrees of susceptibility of not only organs as a whole, as the kidney and the brain, but the individual difference in susceptibility of the component cells of the various organs. Furthermore, certain functions of the organ may be lost while the cells performing these functions may survive. Again, some functions of the cells may be retained, while others may be lost. Finally the loss of function may be temporary; if so, have these cells been partially reconstructed physically? Many of these questions we are not prepared to answer. Indeed, as they relate to the practice of surgery many are not important. The finer metabolic changes, the ultimate method of re-animation or regeneration, may be left to the trained physiologist to determine. What we, as practitioners, want to know is, how long may the

various organs and tissues be deprived of their circulation and still be susceptible to resuscitation? How may resuscitation be best accomplished?

The skin may be removed, preserved for at least several weeks, then on proper planting may grow again. The voluntary muscles enter into a state of rigor mortis after an anemia of about twelve hours. The nerves ending in the muscles degenerate after a shorter period. The bones endure an anemia longer than the muscles. The tendons and connective tissue occupy a position probably between muscle and bone. In a decubitus, as a paralytic bed sore, one observes early necrosis of all the tissues lying between the skin and the bone, showing their greater susceptibility. As to the viscera, the kidney may endure anemia and anatomically survive after a total anemia of at least one hour. The intestinal tract may anatomically and physiologically survive between six and seven hours. The heart (Kuliabko) has been isolated and kept in refrigeration for forty-four hours and on perfusion with oxygenated defibrinated blood has again beat rhythmically. Bloodvessels have been transplanted after isolation for many weeks and have been able to perform at least their passive function (Carrel, Guthrie). Just how long they may retain their viability has not been precisely determined.

The several parts of the central nervous system endure anemia in varying degrees. The respiratory centre may endure an anemia of from thirty to fifty minutes; the vasomotor and cardiac centres, about twenty to thirty minutes; the spinal cord, eight or ten minutes; the motor cortex, eight or ten minutes; that part of the brain presiding over consciousness, the intellect and the psychic state, six to seven minutes.

The foregoing are approximate figures and include only the grosser functions. They permit certain generalizations: (1) Tissues and organs of low specialization endure total anemia better than tissues and organs of high specialization; (2) in the central nervous system the component parts endure anemia according to their phylogeny (Stewart). The nerve tissue presiding over the basal functions of life endures anemia better than the nerve tissue which by the process of evolution differentiates the higher animals from the lower; (3) the weakest link in the entire vital chain in the central nervous system is that which presides over conscious life and its special manifestations; (4) the higher the development of the tissue the more sharply is the period of endurance to anemia marked. While the vasomotor and the respiratory centres may show very considerable variation in their resistance to anemia, the cerebrum varies but slightly.

The histological changes will be alluded to later. Having surveyed in a general and summarizing way the susceptibility to complete anemia of the various tissues and organs that may be of surgical interest, the natural corollary is an inquiry into the methods of resuscitation.

Resuscitation may be considered with reference to organs or tissues individually or to the body as a whole. The best resuscitation is prevention. Here, again, as in the inquiry as to the length of time the tissues and organs may endure total anemia, the subject is so large that details must be sacrificed to a survey of the general field. One is tempted to discuss the ischemic palsy of tight splints, forgotten Esmarch bandages, tourniquets, the pernicious use of a bandage applied directly to the skin over fractures, splint contact with bony prominences, making the heel bear the weight of the splint-bound leg, the long unshifted recumbency upon an unprotected glass- or metal-topped operating table, the pressure of the brachial plexus upon the head of the humerus when the hands are firmly tied above the head during operations, the indentations and insufficient protection of plaster-of-Paris bandages, the unchanged posture on unsuitable mattresses of unconscious or paralyzed patients who have lost the beneficent protection of pain, etc. All these ways and means of causing needless deformity, gangrene, and suffering tempt more consideration, but I must hasten to other problems.

In anemia due to external or mechanical agents the cause and the treatment are obvious. When due to occlusion of supplying vessels, is there a newer method of attack? The work of Carrel, Payr, and others has, at least, furnished means of possible substitution. The perfection of the technique of bloodvessel anastomosis, the success of heteroplastic transplantation of bloodvessels, the establishment of the substitution of a vein for an artery, the use of local, intraneural, spinal, and nitrous-oxide-oxygen anesthesia to obviate shock in poor surgical risks, make it possible at least to determine to what extent the cases of thrombosis, embolism, aneurysm, or traumatic solution of continuity of vessel walls may be benefited by repair or by substitution of vessels. In addition, the direct transfusion of blood may meet the resulting emergencies of acute anemia due to shock and hemorrhage.

In the possible transplantation of organs we must reckon with the effect of anemia as well as with the technical difficulties of the operation. In anemia of the somatic and certain visceral parts there is ample warning and fair surgical opportunity; for even if death does occur, compensations, even regenerations, are generous. In anemia of the central nervous system the warning is momentary or absent, the damage wrought is swift and irremediable. Though the results of anemia here are swift and terrible and the resulting loss of function largely without compensation or repair, we still have left to us the vast and useful field of prevention. Among many subjects may be mentioned the prevention of partial but increasing anemia, due to pressure upon the spinal cord following injuries and tumors. In total cross lesion of the cord there remains no direct surgical problem, but in pressure upon the cord, even though there is but the slightest or even doubtful evidence of function remaining, a speedy

operative relief should be attempted, lest the resulting increase of pressure due to the consequent swelling or oozing may, by producing complete anemia, extinguish the remaining spark of life. Then, too, one must here reckon with the misleading shock phenomena (Sherington) immediately following the trauma, causing a break in the synapses, mimicking for the time being the picture of a total cross lesion. Hill, Stewart, and others have shown that even a slight "dribble of blood" may for a time preserve vitality.

The brain is frequently subjected to local anemia from a variety of mechanical causes, such as gravity, embolism, ligature, and compression of the common or internal carotid arteries, and increased intracranial pressure.

Embolism of surgical interest may be produced by the washing away of the thrombus formed in the proximal stump of a ligated external carotid. This occurs approximately once in fifty such ligations. Ligation of the common or internal carotids, especially in the state of atheroma, in about one out of three cases, is followed by an anemia so marked that cerebral softening occurs. The younger the subject, the less prone to the sequence of softening. But it is the older and atheromatous subjects that usually require or are supposed to require, ligation. Ligation of the common or of the internal carotid has been most frequently performed as a part of the technique of excision of malignant tumors. A closer study of cancer invasion has shown that cancer attacks the wall of the artery only after it has broken through the capsule of the lymphatic glands and has extensively invaded the deep planes of the neck. It is doubtful whether or not such a case has ever been cured by operation. Our position, then, may be stated as follows: If the cancer has not invaded the wall of the artery, ligation is not necessary; if the wall has been invaded the case offers but a remote if any chance of cure. Is this slight chance worth a 33 per cent. risk of cerebral softening?

In aneurysms the development of the technique is constantly diminishing the number of ligations.

As to the ligation of the common or the internal carotids for the arrest of hemorrhage, our means of successfully combating it by methods not bearing the risk of cerebral softening are almost uniformly adequate. In young subjects the sequence of softening is rarely observed. But what young patient requires such ligation? If, however, ligation must be performed, if time permits, a series of preliminary compressions of the artery, either by applying a clamp directly or by indirect external pressure, apparently widens the collateral blood paths, rendering occlusion less harmful. This is apparently established by both clinical and experimental evidence. Temporary closure of the common carotid by means of a special clamp has been done by me nearly one hundred times. In a few cases I simultaneously closed both common carotids. In addition I have frequently placed the patient in a sharp feet-down

inclined posture to enlist the additional aid of gravity in minimizing the venous hemorrhage. The results with respect to the circulation through the brain may be summarized as follows:

In cases of simultaneous closure of both carotids but little anesthetic was required; in one instance respiration failed; in three, recovery of consciousness was delayed. These phenomena were such unmistakable signals of danger from anemia that simultaneous double closure was abandoned. In atheromatous subjects closure of one internal carotid in prolonged operations has been followed by delayed postoperative recovery of consciousness. In one case, in which, in addition, the patient was in a markedly inclined feet-down posture, there was fairly well-marked delirium during three days following the operation. Normal convalescence followed. These were undoubted examples of anemia sequences.

These observations led me further to modify the technique by first closing the common carotid and maintaining the horizontal position until the dissection has been carried to the bifurcation of the carotid, when the clamp is transferred to the external carotid. The blood path now being opened to the brain, no harm follows the inclined feet-down posture. I have observed no anemic phenomena in cases thus handled. Not only does the transfer of the clamp to the external carotid remove the risk of brain anemia, but the closure of the external carotid prevents the moderate bleeding from the reverse current when the common carotid only is closed. Then why is not the external the artery of choice? Because the usual occasion for such a dissection is for the eradication of cancer. Entering the neck to secure the external carotid involves a dissection in a region of frequent metastasis, and so the risk of making a local dissemination of the growth, thus defeating the purpose of the operation. With this exception, the external is the artery of choice, especially in elderly subjects.

After certain operations it is desirable to keep the patient in a sitting or half-sitting posture. In such cases the cerebral circulation, which gravity tends to diminish, may be measurably protected by efficient bandaging over rough elastic cotton to the costal border, or the use of the pneumatic rubber suit under firm distention.

Turning from regional cerebral anemia to the diminution or interruption of the blood current in the supplying arteries, I will consider anemia due to local and mechanical causes originating and operating within the skull. Any consideration of this portion of my theme must represent in a large measure the work of distinguished surgeons of this society.

While the rigid skull gives protection from external violence, every point of such protecting quality becomes a corresponding menace from certain pathological states within. How slight is the factor of safety when the brain is subjected to increased intracranial tension! The principal factor of safety is the displacement of cerebrospinal

fluid and the increased general blood pressure in a protective response to the oncoming anemia.

The management of increased intracranial tension may be illustrated by a common form—traumatic hemorrhage. For the purpose of discussing certain practical points relating to the impaired circulation and consequent anemia, intracranial hemorrhages may, with respect to their degree, be roughly classified as follows: In the first stage, that of developing stupor, falling pulse rate, and rising blood pressure, the margin of operative risk is ample, complete anemia is not immediately threatened, and the prognosis is good. In the second stage, that of deep stupor, subtotal or total unconsciousness, slow but rhythmic pulse and maximum but even blood pressure, the margin of operative risk is slender, the prognosis uncertain. In such cases all the sails of compensation are set. There is probably only a slight circulation through certain portions of the brain. Even a moderate fall in the blood pressure due to hemorrhage, shock, or anesthetic complications may leave the cortex in total anemia, which if at all prolonged, say seven or eight minutes, will result in fatal degenerations. In the third stage, that of complete unconsciousness, irregular pulse rate and rhythm, high but irregular blood pressure, anemic degenerations may have already occurred, or there may remain a slight dribble of blood forced in at the crest of the oscillating blood pressure waves, perhaps even at the crest of the respiratory wave. This slight circulation may be barely holding the spark of life. Surgical relief by a faultless technique may save an occasional member of this group. In the fourth stage, that in which the pulse is rapid and the blood pressure falling, the powerful blood pressure mechanism has spent its force and is broken, the brain is in complete anemia, and widespread degeneration has occurred. The higher-brain individual is dead, while the remainder of the body lives.

This is merely a crude and artificial sketch of the stages through which the brain may pass in the various degrees of anemia due to increased intracranial pressure. The surgical approach here must be as physiological as possible. Not only must there be no depression of the circulation, but support should be given. The blood pressure should be supported by therapeutic and by mechanical means. The posture should be horizontal or head down, the extremities and the abdomen to the costal borders subjected to pressure or bandaging over cotton. The most important consideration, however, is prompt operative decompression. How many of these cases, still dimly conscious, are subjected to the routine method of "interne" anesthesia, of needless hemorrhage, and a shock producing technique. The diagnosis may be correct, a large mass of clot removed, the circulation and the respiration may at once improve, and the surgeon may be entirely satisfied. All is well, but the patient does not regain consciousness and dies. Such a picture I can vividly

recall from personal experience. Causes of increased intracranial tension need strict physiological interpretation.

With this brief and imperfect survey of surgical anemia from local causes, and local resuscitation, I will discuss from the experimental and clinical standpoints resuscitation of the individual as a whole.

After testing current methods and noting their shortcomings, resuscitation was approached from the arterial side, with the following physiological factors as a basis: The physiological researches of Ringer, Kuliabko, Stewart, Sollman, and others had shown that the excised heart could be made to beat again, even many hours after excision, when the coronary arteries were subjected to a considerable pressure from the circulating medium. The researches of Sollman showed that the inauguration of the heart beat was more dependent upon the physical factor of the increased pressure in the coronary arteries than upon the quality of the fluid producing such pressure. He was able to inaugurate cardiac beats by perfusing the coronaries with metallic mercury. The basic problem, then, in resuscitation seemed to us to be that of securing by means of some infusion a coronary pressure in the intact animal to this height by means of cardiac massage alone; it was almost impossible to raise it by means of infusion of artificial sera alone, and generally impossible to raise it to this height by means of cardiac massage and plain infusion combined.

The value of adrenalin in raising the blood pressure, by its action upon the vascular walls in the state of suspended animation, has already been thoroughly established. Introducing the adrenalin into the venous circulation, while easy and practical, had the following disadvantage: the adrenalin first came in contact with the vessels having the least power of influencing the blood pressure, and before a material rise could be affected by its action upon the arteries it was necessary that the solution should pass through the right heart, the lungs, and then back to the left heart on its way to the aorta, then finally affecting the coronary arteries. In a previous research it was found that this too often caused an accumulation of solution and blood in the dilated paralyzed chambers of the heart, defeating resuscitation.

It seemed reasonable to us to suppose that the most direct and effective way of producing a coronary pressure amounting to 40 or more mm. of mercury was by introducing a solution of adrenalin into the arterial system toward the heart. In this way the moment the adrenalin was introduced it caused a contraction of the strong arterial walls, and began to produce an arterial pressure which was communicated directly to the coronary arteries without first passing directly through the already distended and paralyzed chambers of the heart and through the lungs. These considerations were strongly impressed upon us by a clinical case of suspended animation in the

course of a cerebellar operation on a child, which was unexpectedly resuscitated by centripetal arterial infusion of adrenalin.

The following will serve as an illustration: An animal was killed by chloroform. A cannula was inserted into the femoral artery and directed toward the heart. After five minutes artificial respirations were begun and the saline solution was allowed to flow for perhaps ten seconds; then a hypodermic injection of from 1 to 2 c.c. of 1 to 1000 solution of adrenalin was given into the tube near the cannula. A few seconds later the blood pressure began to rise steadily; then a few firm pressures upon the thorax over the heart caused a leaping up of high pulse waves, and at the end of three-quarters of a minute the heart beat vigorously, driving the blood up into the infusion bottle, which had been to the height of five feet. The saline injection and the cardiac massage were discontinued, and in a few minutes irregular respirations began slowly, and increased in force and frequency until the normal was established. The animal was then definitely killed.

Having established an effective technique for resuscitation, we then investigated the physiological and histological sequels of the resulting anemia. The laborious task of collecting these data was undertaken by my colleague, Dr. David H. Dolley.

In general the following sequence of return of the various functions and reflexes was exhibited: vasomotor action, respiration, corneal reflex and knee-jerk (tendon reflexes in general), winking, cutaneous reflexes, partial or complete contraction of the pupils, and light reflex. This order was subject to considerable variation, which will be considered under the special discussions of functions and reflexes. Hypertonicity of the voluntary musculature immediately succeeded recovery of a normal tone and was manifested by exaggeration of the knee-jerks, if not by a more or less widespread spastic condition. It always followed rapidly the re-appearance of the knee-jerk. Reflex muscular movements, secondary to skin or tendon stimulation, always preceded those of spontaneous origin. Spontaneous incoördinate movements appeared sometimes before, sometimes after the light reflex, but afterward only when it returned relatively early. Coördinate movements followed quickly in dogs subjected to short periods of anemia, so that perhaps the incoördinate did not appear, but the resumption of muscular activity was sudden, the dog starting up as though suddenly roused from sleep. Succeeding the coördinate movements there came what may be classed as purposeful movements, involving all the muscles of locomotion and expressed in such actions as attempts to turn over, to rise, or to crawl forward. Usually after the appearance of coördinate movements, less frequently about the same time, visual and auditory reactions were obtained. The auditory was always the more definite and usually returned first. It is the combination of the return of the special senses with purposeful muscular movements, altogether or in

part, that is termed consciousness, though it is usually very dim and uncertain. In many of the dogs that succumbed, after some hours there was more than a mere reflex revival, there being some manifestation of the higher faculties in addition.

SUMMARY. To determine the limits of recovery after a total anemia of the central nervous system, 20 dogs were killed by chloroform and resuscitated after varying times from three to fourteen minutes. Under five minutes the recovery of function was rapid and strikingly free from the after-effects which characterized longer periods. Of seven animals, resuscitated between the periods of five and six and one-half minutes, only one died, apparently as a direct result of the anemia; but of 12 resuscitated between the periods of seven and eight and one-half minutes, only one, after seven and one-half minutes, recovered. The remaining dogs all died.

Histological examination both of presumptive recoveries and fatal cases was made by ordinary methods and those of Nissl and Marchi. The neurocytes of the fatal cases uniformly presented the greatest changes, not merely chromolytic but here and there definitely indicative of cell death. Marchi's method further supported these findings by proving the existence of fiber degeneration. Finally, showing the narrowness of the escape, the best result in recovery, seven and one-half minutes in time, which at the end of four weeks had apparently entirely returned to a normal state, by the Marchi method had a degeneration of a number of fibers localized in the pyramidal fasciculi which were traced from the cord to the cortex, and in Flechsig's fasciculus, as well as a more sparsely scattered degeneration of both ascending and descending fibers elsewhere.

In human resuscitation the technique is as follows: The patient in the prone posture is subjected at once to rapid rhythmic pressure upon the chest, with one hand on each side of the sternum. This pressure produces artificial respiration and a moderate artificial circulation. A cannula is inserted toward the heart into an artery. Normal saline, Ringer's, or Locke's solution, or, in their absence, sterile water, or, in extremity, even tap water, is infused by means of a funnel and rubber tubing. But as soon as the flow has begun the rubber tubing near the cannula is pierced with the needle of a hypodermic syringe loaded with 1 to 1000 adrenalin chloride and 15 to 30 minims is at once injected. Repeat the injection in a minute if needed. Synchronously with the injection of the adrenalin the rhythmic pressure upon the thorax is brought to a maximum. The resulting artificial circulation distributes the adrenalin that spreads its stimulating contact with the arteries, bringing a wave of powerful contractions and producing a rising arterial, hence coronary pressure. When the coronary pressure rises to, say, 40 mm. or more, the heart is likely to spring into action. The first result of such action is to spread still further the blood pressure-raising adrenalin, causing a further and vigorous rise in blood pressure, possibly even doubling

the normal. The excessively high pressure is most favorable to the resuscitation of tissue, especially of the central nervous system (Stewart). Just as soon as the heart beat is established the cannula should be withdrawn, first, because it is no longer needed, and second, because the rising blood pressure will drive a torrent of blood into the tube and funnel. Unless there has been hemorrhage, the only object in the use of saline infusion is to serve as a means of introducing the adrenalin into the arterial circulation toward the heart. Bandaging the extremities and abdomen tightly over masses of cotton is very useful.

From a personal experience in attempts at resuscitation of the human being, I have been impressed by two main facts: (1) The human heart seems to respond even more readily than the heart of a dog; (2) the possibility of drilling an operative staff so that the technique may be begun within two minutes.

Prior to our knowledge as to the remarkably rapid degeneration of the central nervous system I attempted a variety of cases, including drowning, electrocutions from live wire accidents, and traumatisms. I usually succeeded in establishing a heart beat, sometimes a fairly good respiratory rhythm. In one case the patient lived some days, but did not regain consciousness. Only one recovered. The most interesting case was that done by my staff at Lakeside Hospital. In the course of a neck dissection the patient suddenly collapsed. The heart, the vasomotor, the cardiac, and the respiratory centres, after approximately nine minutes of total anemia, were resuscitated. The patient died in twenty-four hours. Consciousness did not return; the pupils remained dilated, the lids half closed; there was complete muscular relaxation; the special senses were all paralyzed; all reflexes were lost; he was in appearance and in fact a decerebrate.

This method of resuscitation may be quickly executed. It involves but a slight operation. It does not in itself complicate the patient's chance for ultimate recovery.

Centripetal arterial infusion with adrenalin combined with rhythmic pressure on the chest seems to be a more effective method than that by the use of stimulants, nitroglycerin, intravenous infusions, electricity, needling the heart, and even of direct cardiac massage. We must admire the courage and the boldness of the surgeons who have attempted resuscitation by direct cardiac massage. According to our present views, in many of these cases the brain was dead before the cardiac massage was even begun. There are degrees of anemia, hence there are degrees of resuscitation.

In hemorrhage and in shock the blood pressure may be so low as to cause temporary damage to the central nervous system. An analogous degeneration is seen in pernicious anemia. Bearing in mind its grave consequences, anemia should not, if possible, be permitted beyond a certain degree. Should other measures fail, the direct transfusion of blood is, in uncomplicated cases, virtually a specific

remedy. Not only the various tissues and organs of the body but the various component histological elements have an unequal endurance of anemia. Bone, connective tissue, muscle, skin, abdominal and thoracic viscera, special glands, and the heart and blood-vessels endure anemia many times longer than the central nervous system. The medulla endures anemia much better than the cerebrum. The higher the function the greater is the susceptibility to anemia. Histological changes are definite. Resuscitation to be effective must be timely. Timely resuscitation can only be done by having ever in readiness the materials needed for the technique.

THE INFLUENCE OF EMOTIONAL STATES ON THE FUNCTIONS OF THE ALIMENTARY CANAL.¹

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THE contraction of bloodvessels with resulting pallor, the pouring out of "cold sweat," the stopping of salivary secretion so that the "tongue cleaves to the roof of the mouth," the dilatation of the pupils, the erection of the hairs, the rapid beating of the heart, the hurried breathing, the trembling and twitching of facial muscles, especially those of the lips—all these bodily changes are well recognized attendants of major emotional disturbances, such as fear, horror, and deep disgust. It is well known also that these changes occur chiefly in structures supplied with smooth muscle and innervated through the sympathetic nervous system. But these bodily emotional alterations, commonly noted, are mainly superficial and readily observable. Even the increased rapidity of the heart beat manifests itself in the periphery. There are, however, other viscera, supplied with smooth muscle and innervated by sympathetic fibers, which are hidden deeply in the body and which do not reveal so obviously as do the structures already mentioned the disturbances of function accompanying affective states. Special methods must be used to determine whether these organs also are included in the complex of an emotional agitation.

The bladder, for example, as Mosso has shown, is extraordinarily sensitive to mental states involving interest and attention.² That the tone of the bladder is much increased during excitement might be inferred from the common experience of soldiers before moving

¹ In the use of the term "emotion" in this paper the meaning is not restricted to violent affective states, but includes "feelings" and other affective experiences. The term is also used in the popular manner, as if the "feeling" preceded the bodily change.

² Decennial Celebration, Clark University, 1899, p. 396.

into the firing line, of students facing the ordeal of an examination, of speakers about to go before an audience—in all these instances the increasing tone of the bladder muscle makes an insistent demand. The observations of the physiologist have merely refined these general experiences and made clear the paths of the nervous impulses and the degree of sensitiveness of the peripheral organ to excitation in the central nervous system.

The development of our knowledge of the relations of emotions to the functioning of the alimentary canal is similar. There are references in medical and other literature to the effects, favorable and unfavorable, of mental states on digestion. These instances are not uncommon in the observations of medical practitioners. The recent studies by the physiologists have merely proved specifically and in detail the disorders of function which ensue when feelings are aroused. It will be of interest to note some of the conditions attended by digestive disturbances, and later the refinements of our knowledge of these conditions discovered by recent experimental work, and certain practical conclusions to be drawn therefrom.

An interesting case illustrating the influence of a mental state on the activities of the alimentary canal is given by Burton³ in his *Anatomy of Melancholy*. "A gentlewoman of the same city saw a fat hog cut up, when the entrails were opened, and a noisome savour offended her nose, she much disliked, and would not longer abide; a physician in presence told her, as that hog, so was she, full of filthy excrements, and aggravated the matter by some other loathsome instances, insomuch this nice gentlewoman apprehended it so deeply that she fell forthwith a vomiting, was so mightily distempered in mind and body, that with all his art and persuasion, for some months after, he could not restore her to herself again, she could not forget or remove the object out of her sight." Truly, here was a moving circle of causation, in which the physician himself probably played the part of a recurrent augmenter of the trouble. The first disgust disturbed the stomach, and the disturbance of the stomach, in turn, aroused in the mind greater disgust, and thus between them the influences continued to and fro until digestion was impaired and serious functional derangement supervened. The stomach is "king of the belly," quotes Burton, "for if he is affected all the rest suffer with him."

Müller⁴ has reported the case of a young woman whose lover had broken the engagement of marriage. She wept in bitter sorrow for several days, and during that time vomited whatever food she took. But not all cases are so severe in their visceral manifestations as this. Sometimes the conditions of mental discord are merely attended by a sense of gastric inertia. For example, another

³ The Anatomy of Melancholy (first published in 1621), London, 1886, Part I, p. 443.

⁴ Deut. Arch. f. klin. Med., 1907, lxxxix, 434.

patient described by Müller testified that anxiety was always accompanied by a feeling of weight in the epigastrium, as if the food remained in the stomach. Every addition of food caused an increase of the trouble. Strong emotional states in this instance led almost always to gastric distress, which persisted, according to the grade and the duration of the psychic disturbance, between a half hour and several days. The patient was not hysterical or neurasthenic, but was a very sensitive woman deeply affected by moods.

These cases are merely illustrative, and doubtless can be many times duplicated in the experience of any physician concerned largely with digestive disorders. Indeed, the opinion is expressed that a large percentage of the cases of gastric indigestion that come for treatment are functional in character and of nervous origin. It is the emotional element that seems most characteristic of these cases. To so great an extent is this true that Rosenbach⁵ has suggested that as a characterization of the etiology of the disturbances, "emotional dyspepsia" is a better term than "nervous dyspepsia."

In recent physiological studies of the alimentary canal the importance of emotional states to normal digestion has received striking confirmation. The motility and the secretory activity have both been proved to be closely dependent on the nature of the excitation in the central nervous system. Pawlow's well-known observations showed the importance of appetite and a relish for food in starting the secretions of the stomach. These observations on dogs have been almost completely confirmed by studies of human beings having œsophageal obstruction and gastric fistula. Hornborg,⁶ Cade and Latarjet,⁷ Bogen,⁸ and others have reported in detail studies of such cases. Hornborg found that when the boy whom he studied chewed agreeable food a more or less active secretion of the gastric juice was started, whereas the chewing of indifferent material was without influence.

Not only is it true that normal secretion is favored by pleasurable sensations during mastication, but also that unpleasant feelings, such as vexation and some of the major emotions, are accompanied by a failure of secretion. Thus Hornborg was unable to confirm in his patient the observation of Pawlow that mere sight of food to a hungry subject causes the flow of gastric juice. Hornborg explains the difference between his and Pawlow's results by the difference in the reaction of the subjects to the situation. When food was shown, but withheld, Pawlow's hungry dogs were all eagerness to secure it, and the juice at once began to flow. Hornborg's little boy, on the contrary, became vexed when he could not eat at once, and began to cry; then no secretion appeared. Bogen also reports that his

⁵ Berl. klin. Woch., 1897, xxxiv, 71.

⁶ Skandinavische Arch. der Phys., 1901, xv, 248.

⁷ Jour. de phys. et path. gén., 1905, vii, 221.

⁸ Arch. f. die ges. Phys., 1907, cxvii, 156.

is present, a child, aged three and a half years, sometimes fell into such a passion in consequence of vain hoping for food that the giving of the food, after calming the child, was not followed by any secretion of the gastric juice.

The observations of Bickel and Sasaki⁹ confirm and define more precisely the inhibitory effects of violent emotion on gastric secretion. They studied these effects on a dog with an œsophageal fistula, and with a side pouch of the stomach, which, according to Pawlow's method, opened only to the exterior. If the animal was permitted to eat while the œsophageal fistula was open, the food passed out through the fistula and did not go to the stomach. Bickel and Sasaki confirmed the observation of Pawlow that this sham feeding is attended by a copious flow of gastric juice, a true "psychic secretion," resulting from the pleasurable taste of the food. In a typical instance the sham feeding lasted five minutes, and the secretion continued for twenty minutes, during which time 66.7 c.c. of pure gastric juice was produced.

On another day a cat was brought into the presence of the dog, whereupon the dog flew into a great fury. The cat was soon removed, and the dog pacified. Now the dog was again given the sham feeding for five minutes. In spite of the fact that the animal was hungry and ate eagerly, there was no secretion worthy of mention. During a period of twenty minutes, corresponding to the previous observation, only 9 c.c. of acid fluid was produced, and this was rich in mucus. It is evident that in the dog, as in the boy observed by Bogen, strong emotions can so profoundly disarrange the mechanisms of secretion that the natural nervous excitation accompanying the taking of food cannot cause the normal flow.

On another occasion Bickel and Sasaki started gastric secretion in the dog by sham feeding, and when the flow of gastric juice had reached a certain height, the dog was infuriated for five minutes by the presence of the cat. During the next fifteen minutes there appeared only a few drops of a very mucous secretion. Evidently in this instance a physiological process, started as an accompaniment of a psychic state quietly pleasurable in character, was almost entirely stopped by another psychic state violent in character.

It is noteworthy that in both the positive and negative results of the emotional excitement illustrated in Bickel and Sasaki's dog the effects persisted long after the removal of the exciting condition. This fact Bickel¹⁰ was able to confirm in a girl with œsophageal and gastric fistulas; the gastric secretion long outlasted the period of eating, although no food entered the stomach. The importance of these observations to personal economics is too obvious to require elaboration.

Not only are the secretory activities of the stomach unfavorably

⁹ Deut. med. Woch., 1905, xxxi, 1829.

¹⁰ Berl. klin. Woch., 1906, xliii, 845.

affected by strong emotions; the movements of the stomach as well as, indeed, the movements of almost the entire alimentary canal, are wholly stopped during excitement. In my earliest observations on the movements of the stomach¹² I had difficulty, because in some animals the peristalsis was perfectly evident and in others there was no sign of activity. Several weeks passed before I discovered that this difference in response to the presence of food in the stomach was associated with a difference of sex: the male cats were restive and excited on being fastened to the holder, and under these circumstances gastric peristalsis was absent; the female cats, especially if elderly, submitted with calmness to the restraint, and in them peristaltic waves took their normal course. Once a female with kittens turned from her state of quiet contentment to one of apparent restless anxiety. The movements of the stomach immediately stopped, and only started again after the animal had been petted and had begun to purr. I later found that by covering the cat's mouth and nose with the fingers until a slight distress of breathing occurred, the stomach movements could be stopped at will. Thus, in the cat any sign of rage, such as Bickel and Sasaki's dog manifested, or distress, or mere anxiety, was accompanied by a total cessation of the movements of the stomach. I have watched with the x-rays the stomach of a male cat for more than an hour, during which time there was not the slightest beginning of peristaltic activity, and yet the only visible indication of excitement in the animal was a continued to-and-fro twitching of the tail.

What is true of the cat has been proved true also of the rabbit, dog, and guinea-pig—even slight psychic disturbances were accompanied by stoppages of peristalsis.¹³ My observations on the rabbit have been confirmed by Auer,¹⁴ who found that the handling of the animal incident to fastening it gently to a holder stopped gastric peristalsis for a variable length of time. And if the animal was startled in any way, or struggled, peristalsis was again abolished. The observations on the dog also have been confirmed; Lommel¹⁵ found that small dogs in strange surroundings might have no movements of the stomach for two or three hours. And whenever the animals showed any indications of being uncomfortable or distressed the movements were inhibited and the discharge from the stomach checked.

Like the peristaltic waves of the stomach, the peristalsis and segmenting movements of the small intestine and the antiperistalsis of the large intestine all cease whenever the observed animal manifests signs of emotional excitement.

¹¹ The lower part of the large intestine may have an increased activity during excitement, so that there is involuntary voiding of the gut. See Darwin, *Expression of Emotions in Man and Animals*, New York, 1873, p. 77.

¹² *Amer. Jour. Phys.*, 1898, i, 380.

¹³ *Ibid.*, 1907, xviii, 356.

¹⁴ *Amer. Jour. Phys.*, 1902, viii, xxii.

¹⁵ *Münch. med. Woch.*, 1903, i, 1634.

There is no doubt that just as the secretory activity of the stomach is affected in similar fashion in man and in lower animals, so likewise gastric and intestinal peristalsis are stopped in man as they are stopped in the lower animals, by worry and anxiety and the major affective states. Indeed, the feeling of heaviness in the epigastrium commonly complained of by nervous persons may be due to the stagnation of food. That such stagnation occurs is shown by the following case: A refined and sensitive woman who had had digestive difficulties, came with her husband to Boston to be examined. They went to a hotel for the night. The next morning the woman appeared at the consultant's office an hour after having eaten a test meal. An examination of the gastric contents revealed no free acid, no digestion of the test breakfast, and the presence of a considerable amount of the supper of the previous evening. The explanation of this stasis of the food in the stomach came from the family doctor, who reported that the husband had made the visit to the city an occasion for becoming uncontrollably drunk, and that he had by his escapades given his wife a night of turbulent anxiety. The second morning, after the woman had had a good rest, the gastric contents were again examined; the proper acidity was found, and the test breakfast had been normally digested and discharged.

It is of interest to know by what paths the inhibitory impulses, which stop the movements of the stomach and intestines, pass from the central nervous system to these organs. Pflüger¹⁶ proved many years ago that stimulation of the splanchnic nerves inhibits the movements of the intestines. Pflüger's discovery has since been confirmed by many observers. There is a difference of opinion concerning the effect of sympathetic impulses on the stomach. Most investigators have attributed to these impulses inhibitory functions alone; but Morat¹⁷ has noted the opposite effect, and Openchowski¹⁸ reports that in the rabbit the sympathetic has mainly a motor influence on gastric peristalsis. May¹⁹ failed to find that stimulation of the splanchnic nerves had any effect whatever on the stomach.

Four years ago, during the course of an investigation of the motor activities of the alimentary canal after section of the splanchnic and vagus nerves, I had occasion to observe the effects of excitement on these activities after various nervous connections had been destroyed.²⁰ Under these circumstances such nerves as were left received impulses normally and delivered them normally to the peripheral organ. The conditions, therefore, were highly favor-

¹⁶ Ueber den Hemmungsnervensystem f. den peristaltischen Bewegungen der Gedärme, Berlin, 1857.

¹⁷ Arch. phys., 1893, xxv, 153.

¹⁸ Jour. Phys., 1904, xxxi, 264.

¹⁹ Centralbl. f. Phys., 1889, iii, 4.

²⁰ For a preliminary notice of these results, see Cannon, Amer. Jour. Phys., 1905, xiii, xxii

able for determining the course of inhibitory paths. When the vagus nerves were severed and the splanchnic nerves alone remained, respiratory distress caused the usual total cessation of the movements of the stomach and small intestine. Impulses along the splanchnic nerves, therefore, inhibit not only the intestines, but the stomach as well. When the splanchnic nerves were cut and the vagi alone remained, respiratory distress had no effect on the movements of the small intestine, but if prolonged until the animal began to toss about, gastric peristaltic waves became very shallow or momentarily stopped. From this evidence it would appear that the vagi convey to the stomach not only the motor impulses generally attributed to them, but also inhibitory impulses, although these latter are not nearly so efficient in stopping gastric peristalsis as are the impulses delivered by the splanchnics. When the splanchnic and vagus nerves are all cut, it is impossible to stop the movements of the alimentary canal by respiratory distress. The stoppage in the former cases cannot, therefore, be attributed to any other agency than the nervous influence, as, for example, to asphyxia.

The foregoing exposition of the influence of emotions on the activities of the stomach and intestines has shown how profoundly the mental state may affect favorably or unfavorably the secretions of the stomach, so important for the continuation of the digestive process, and how quickly and directly the mental state may entirely check the onward movement of the food. As already noted, an emotional disturbance affecting the alimentary canal is capable of starting a vicious circle; the stagnant food, unprotected by abundant gastric juice, naturally undergoes bacterial fermentation, with the formation of gases and irritant decomposition products. These, in turn, may produce mild inflammation or be absorbed as substances disturbing to metabolism, and thus affect the mental state. And the depressed mental state that accompanies "indigestion" may still further prolong the indigestion. The importance of avoiding so far as possible the initial states of worry and anxiety, and of not permitting grief and anger and other violent emotions to prevail unduly, is not commonly understood, for the subtle changes wrought by these emotional disturbances are not brought to consciousness, and are clearly known solely through physiological studies. Only as these effects are better understood can the bad results be avoided, or, if not avoided, regarded and treated with intelligence.

The influence of emotions on digestive functions is as important a consideration for the physician as it is for the patient. On the basis of this consideration Kast²¹ has already pointed out the precautions necessary in order to make sure that the analysis of a test meal reveals the usual conditions of the patient. Announcing

²¹ Berl. klin. Woch., 1906, xliii, 708.

that a stomach tube is to be passed may cause serious apprehension. The tube should not be mentioned until immediately before its introduction into the œsophagus. And with easily excitable persons caution should go even farther—the meal should be eaten at home with the customary surroundings, so that no disturbing element is permitted to affect the normal processes. The necessity of taking into account the psychic state in judging the results of gastric examinations is well illustrated by the case of the woman with the riotous husband, already cited. How many cases reported as showing anacidity have had such causes acting in the background?

It would probably be an error to assume a predominant importance of the psychic state in the causation of digestive disease. The facts brought forward in this paper indicate, however, that the mental state of a person complaining of digestive difficulty may have marked effects on both the motility and the secretion of the alimentary tract. The mental state of the patient, therefore, must be considered before passing judgment on the nature of his trouble, for just as feelings of comfort and peace of mind are fundamental to normal digestion, so discomfort and mental discord may be fundamental to disturbed digestion.

THE MEANING OF HEMATEMESIS.

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THE vomiting of blood is always a highly dramatic event. To the patient as well as to observers it is so unusual and so extraordinary an incident that it never fails to excite consternation and alarm. To the physician, on the other hand, it is not so much the occurrence itself that appeals, as the meaning of it: for he knows that some grave pathological change always lies behind this symptom, and that the discovery of what this change may be alone will determine the true significance of the episode. But the problem is never a simple one and its solution is never easy. The best that one can do in any case is to consider all the possibilities that may underlie the hematemesis; then to examine the patient in every possible way for other evidences of disease; and to try by sifting these to explain which possibility lies the nearest to probability. Absolute certainty in explanation is not possible here, as he knows best who has followed his cases most often to the operating table or to the autopsy room. What then are these possibilities of which one has to think?

I. *Cirrhosis of the liver* is the condition that probably comes first to mind when a patient vomits blood, especially if the individual

is in middle life, has a history of habitual overindulgence in alcohol, has made little or no previous complaint, and brings up a copious amount of blood without warning and without pain; and when the physical examination reveals nothing except a decreased or increased area of liver dulness and enlargement of the spleen, in addition to the secondary anemia caused by the loss of blood. A first hemorrhage of this sort is rarely fatal and, therefore, the diagnosis under such circumstances can be set down only as a reasonable probability. The following case presents the usual picture of hematemesis due to cirrhosis of the liver:

CASE I.—In December, 1905, I was called to see a man, aged forty-seven years, who suddenly began to vomit blood, and five different times during one day brought up large quantities of blood. He had always been perfectly well previously, but had taken whiskey steadily and to excess for years. He was found to have enlargement of the liver and of the spleen, but no other evidence of organic disease. He has never vomited blood since then; but has continued his abuse of alcohol, and is now suffering from morning vomiting each day and complains frequently of pain in the region of his liver.

But if the patient is not seen until months or years after the first vomiting of blood, developments probably will have occurred that enable one to attribute the hematemesis with greater confidence to cirrhosis of the liver. If there is a history of such a hemorrhage years before, followed gradually by more or less persistent morning vomiting, distress, and belching after food, irregular bowel movements, capricious appetite, and disturbed nutrition, we feel more certain about the meaning of this early hemorrhage than we could have been at the time that it took place. The following case demonstrates this fact, but shows also that even when a diagnosis appears most definite, the whole truth may not be recognized.

CASE II.—A man, aged sixty years, was first seen in May, 1908, complaining of morning vomiting for the past ten or twelve years, more or less pain and soreness over his stomach for months previous, flatulence, and belching after food. He stated that twelve years before he had vomited a large amount of blood, and again a second time three weeks after the first, but never since. For many years he had used whiskey steadily and to excess, never less than two gallons a month. His liver was found enlarged and tender, measuring 14 cm. in the nipple line; his spleen likewise was enlarged, measuring 10 cm. in the anterior axillary line. He had also a general advanced arteriosclerosis, but no evidence of disease of the heart or kidneys. During May he ran down rapidly in weight and strength, and on the 28th and 29th had profuse hemorrhage from his bowels, but at that time no blood was vomited. Following that he rapidly developed ascites. The abdomen was tapped on June 30 and one gallon of fluid removed, but it rapidly recurred. From that time on he gradually grew weaker and more exhausted until his death

on July 22. The autopsy revealed cirrhosis of the liver, chronic splenitis, and chronic gastritis. But in addition to these, which had been diagnosticated clinically, there was found a primary adenocarcinoma of the liver, with metastasis in the colon and in a lymph gland in the head of the pancreas.

The hematemesis of cirrhosis is usually early, is usually copious, and is usually followed by no further bleeding for months or years, if at all. These points are depended upon for diagnosis, but here, as elsewhere in clinical medicine, there are exceptions to the rule. The hematemesis may not occur until late in the course of the disease, may be repeated throughout several days and may thus become the direct cause of death. It has been shown by different observers that the source of the hematemesis in hepatic cirrhosis is most often a dilated vein in the lower end of the œsophagus that has ruptured from overdilatation and from thinning of its wall. Usually the amount of blood poured out into the stomach from this source is so large that vomiting soon occurs from overfilling of the viscus. But if the amount discharged is small or moderate, it may not be vomited at all, but find its way out through the bowel. A history of tarry stools, long continued or frequently recurring, preceding a hematemesis, is therefore not inconsistent with a diagnosis of hepatic cirrhosis when profuse vomiting of blood finally occurs. The following case illustrates such late hematemesis, leading directly to a fatal outcome; and shows how other symptoms and the previous history may make the diagnosis of hepatic cirrhosis fairly positive, even though the vomiting of blood constitutes the last instead of the first scene in the drama.

CASE III.—A man, aged sixty-four years, entered the Lane Hospital in August, 1908, complaining of vomiting of blood. He had been a saloon keeper for twenty years, and during that time had habitually taken at least three or four drinks of whiskey every day. About a year before he came under my observation he had noticed that his skin became yellow and his stools became black. In January, 1908, he entered another hospital and remained for two months. The jaundice then disappeared for a time, but recurred after he returned home. The stools had remained persistently black and tarry for months. His appetite had been poor, and his food caused indigestion and flatulence, but he did not vomit and had no pain. On August 14, while lying quietly in bed, he suddenly vomited about a quart of dark, clotted blood. This was repeated on the 17th and the 19th, but in smaller amounts. On the 20th and 21st, while in the hospital, he again vomited blood repeatedly and profusely until his death at noon on the latter date. The prominent physical signs were those of decided jaundice, with contracted liver, enlarged spleen, general arteriosclerosis, but no ascites or œdema. The autopsy showed atrophic cirrhosis of the liver, chronic splenitis and perisplenitis, and a ruptured varix in the lower part of the œsophagus.

II. *Gastric ulcer* is usually looked upon as a frequent cause of hematemesis, if not the most frequent. But in my own experience it has not been so, nor, on the other hand, has hematemesis been found a common symptom of gastric ulcer. In 1907 I reported 4 late cases of gastric ulcer in which the diagnosis had been positively demonstrated by operation or by autopsy, in only one of which had there ever been any hematemesis. In by far the largest group of cases coming under my observation the diagnosis of gastric ulcer has been made without this symptom of vomiting blood, while in a number of other cases in which it has occurred and has been depended upon as diagnostic, no gastric ulcer has been found at operation or at autopsy. When hematemesis presents itself, the typical history that speaks for gastric ulcer as a cause is as follows: The patient is usually under middle age; has been suffering for months or years from acid dyspepsia, varying in severity at different times; pain has been a prominent symptom throughout; and the vomiting of blood comes late, after a long-continued period of ill-health. A most characteristic case is the one reported in the group to which I have previously referred.

CASE IV.—A man, aged thirty-eight years, was first seen in August, 1901, complaining of pain in his stomach and vomiting. He had had recurring attacks of stomach trouble similar to this for some years before. His symptoms in detail were pain after food, always worse at night, felt below the border of the ribs on the right side and running through to the back; vomiting occurring at the height of pain and relieving it, the vomited material being very sour, and irritating; much belching and flatulence, tenderness over the epigastrium, and obstinate constipation. He had a persistent hyperchlorhydria, his total acidity varying from 71 to 100 and the free HCl running as high at times as 70. His symptoms all disappeared under treatment in 1901, but all recurred in 1902, with the addition of a sudden profuse hematemesis in August of that year. This vomiting of blood was repeated at intervals of a few days and finally every day until his death on August 28. The autopsy showed an oval ulcer, 2 by 3 cm., lying across the pylorus, one-third in the stomach and two-thirds in the duodenum, with a large branch of the arteria gastroduodenalis lying open in its floor.

But if in a doubtful case the history of which resembles that of gastric ulcer the vomiting of blood be given too much importance in weighing the evidence, errors in diagnosis are likely to arise. In the following case, for instance, the hematemesis was looked upon as the deciding bit of proof that turned the scales.

CASE V.—A woman, aged forty-six years, seen in February, 1908, said that for years previous she had been subject to attacks of indigestion, from which she could obtain relief only by taking large doses of bicarbonate of sodium. These attacks had gradually grown more frequent and more severe. They were characterized by pain

running through from the stomach to the back; vomiting at the height of the pain, which usually gave relief; and at times pain even in the empty stomach, with vomiting of sour fluid. She had three different times vomited blood—once profusely four or five years before; once in April, 1906, following the great fire; and a third time only a day or two before I saw her first. For a week before this last occasion the pain had been unusually severe, with persistent vomiting which gave no relief. She was a very large, obese woman, weighing 218 pounds. The abdominal wall was so thick that satisfactory palpation could not be made, but there was extreme tenderness in the epigastrium and the right hypochondrium. A test meal could not be retained, and therefore no analysis of the gastric contents was made; but from the history and physical examination, the case was looked upon as one of gastric ulcer. Operation by Dr. Emmet Rixford, on February 25, showed, however, that there was no ulcer present. What was found was a greatly distended gall-bladder, containing an abundance of viscid bile and numerous stones, with occlusion of the cystic duct by stones. Since then she has again had several attacks like the old ones, with pain through from the epigastrium to the back, and vomiting of sour, burning material, but never any further vomiting of blood. She undoubtedly has a hyperchlorhydria, but she has no gastric ulcer. The vomiting of blood is unexplained.

The bleeding from a gastric ulcer that leads to hematemesis is usually from a good-sized vessel opened in its base; a considerable amount of blood is poured out quickly, so that vomiting of bright red blood occurs: it is not detained in the stomach long enough to be altered by the acid secretions. But this is not always the case. Smaller vessels may be eroded and the hematemesis may be much less in amount and of dark purple or brownish material instead of bright red blood. In such cases of ulcer, however, the blood is much less likely to be vomited, but rather to pass out into the bowel where it can be detected either by gross inspection or by more delicate tests of the feces. While frequent vomiting of small amounts of altered blood may therefore mean gastric ulcer, especially when associated with a typical ulcer history, it is more likely to mean something else. The following case shows how easy it is to misconstrue symptoms and signs that are usually considered diagnostic.

CASE VI.—A woman, aged seventy years, was first seen at Lane Hospital in August, 1908, during the act of vomiting a few ounces of dark brownish material that tests proved to consist of altered blood. She said that for twenty-five years previous she had had repeated attacks characterized by nausea, burning in the stomach, vomiting and retching, and especially the vomiting of "black stuff." Such attacks had lasted several days or a week. At first they occurred not more than once a year; but gradually they had grown more frequent until now they were almost constant. During the

previous six weeks she had suffered from attacks of vomiting as often as every three or four days, always bringing up "black stuff" and brownish material resembling blood. Food always caused much burning and distress. The patient was a very obese woman, with such an enormous layer of fat over the abdomen that no exact palpation could be made; but she complained of great tenderness in the right hypochondrium on pressure. The test meal showed nothing except a moderate hyperchlorhydria. The case was considered one of chronic gastric ulcer. But the operation by Dr. Rixford on August 8 showed no ulcer present in any part of the stomach. The gall-bladder and ducts were all normal. The only explanation found for the repeated hematemesis was a shrunken, granular, and hardened liver.

It seems clear, therefore, that a profuse hematemesis is to be looked upon as a late complication of long-standing, gastric ulcer, and is never to be awaited before a positive diagnosis is made. The vomiting of small amounts, frequently repeated, of altered blood may mean gastric ulcer, but is always to be looked upon with suspicion as a diagnostic sign, even though a typical ulcer history co-exists. Bleeding from gastric ulcer is common, but vomiting of blood is not. Tarry stools or occult blood in the feces are much more frequently found.

III. *Gastric cancer* is the condition that above all others gives rise to the small, frequently repeated hematemeses, the blood being dark, altered by gastric juice, forming the classical, "coffee-ground" vomitus. The free abundant hemorrhage of cirrhosis or of ulcer is very rare in cancer, though it may occur. With the hematemesis, too, there is a very different history in cancer: of rather sudden onset of gastric symptoms and no lengthy period of indigestion preceding for months or years; of progressive disturbance of strength and nutrition; of loss of appetite, distress soon after food is taken; of belching and persistent vomiting of food long before there is any vomiting of blood. Hematemesis does not occur early and not until ulceration of the newgrowth has taken place; by which time there is commonly a palpable tumor present and absence of free HCl after a test meal. All of these collateral symptoms and signs usually make it easy to decide when hematemesis means cancer of the stomach. But there is one extremely misleading exception, and that is the cancer that originates upon an ulcer base. That this happens not infrequently is gradually coming to be recognized. The following case shows how, under such circumstances, hematemesis of the ulcer type, with characteristic ulcer history and stomach analysis, may nevertheless be a symptom of gastric cancer.

CASE VII.—A man, aged forty-two years, was first seen in November, 1906, complaining of pain in his stomach coming on about two hours after eating, and relieved usually by taking food and always by taking bicarbonate of sodium; also of sour water coming up in his

throat when pain was severe, and of obstinate constipation. He had epigastric tenderness and a succussion splash, and a test meal showed hyperacidity. Under treatment for these symptoms he lost them all temporarily. But he returned for advice in March, 1907, with a recurrence of all the old trouble, and the addition of frequent vomiting of sour water and a history of progressive loss in weight. He again had a marked succussion splash, resistance and rigidity and tenderness in the right hypochondrium, and after the Ewald test meal a total acidity of 50, with the HCl 40. The symptoms did not improve this time under treatment. In April, 1907, he had a very severe attack characterized by much pain and constant vomiting and the vomiting of considerable blood. His test meal now showed a total acidity of 60, with the free HCl 32. He was then put to bed on a rigid treatment for gastric ulcer, but even so continued to vomit quantities of dark, chocolate-colored fluid that tests showed to be altered blood. This happened throughout several days and then ceased. By the end of May he was again up and about but still had pain and vomited at times and had grown very thin, having lost 40 pounds in weight. Still he had no palpable tumor in his abdomen. As his trouble continued during the summer, in spite of lavage and careful dieting, it was finally concluded by several who saw him in consultation that he must be operated upon for dilatation of the stomach caused by a stenosed pylorus from gastric ulcer. This was done in November, 1907, and a carcinoma was found at the pylorus with extensive metastases in the liver, prohibiting any attempt at extirpation. He died a few weeks later.

IV. *Splenic Anemia*. When once we leave the three great causes of hematemesis heretofore mentioned, all the others become unusual and infrequent by comparison. Yet there are several other important conditions that may cause blood to be vomited, and of these splenic anemia is not so very rare. Its diagnostic features are the following: (1) Splenic enlargement; (2) anemia of the chlorotic type, with leukopenia; (3) hemorrhages from the stomach; and (4) terminal ascites with hepatic cirrhosis. The hematemesis may be the first symptom to excite alarm and to cause the patient to seek advice; when the greatly enlarged spleen and the blood count give the clue as to the nature of the disease. The splenic enlargement is usually greater than in hepatic cirrhosis, the anemia has certain peculiar characteristics, and the history is one of weariness, weakness, and dyspnoea, rather than of gastric or intestinal disturbances. The following case of hematemesis seemed to be due to splenic anemia, though it was lost from observation before the opportunity for autopsy arrived, which alone could have made the diagnosis positive.

CASE VIII.—A woman, aged thirty-eight years, consulted me in September, 1905, because she had been told she had cancer of

the stomach. The reason for this diagnosis was the vomiting of a quantity of bright red blood on five different occasions during one week, shortly before I saw her. But she had no other vomiting or gastric distress at any time before or afterward. Her principal complaint was of exhaustion, weakness, and shortness of breath, which symptoms had been present for months before the hemorrhages occurred. She was not at all emaciated, but extremely pale. The spleen was enlarged so that it extended 5 cm. below the border of the ribs. It was hard in consistence and tender on palpation. The liver dulness measured 12 cm. in the mammary line. There was no evidence of disease in the heart, lungs, or kidneys. Her blood counts (made for me by Dr. H. R. Oliver) were as follows: September 14, 1905; reds, 2,500,000; whites, 4800; hemoglobin, 20 per cent.; October 7: reds, 3,000,000; whites, 6000; hemoglobin, 75 per cent. While under observation she developed a moderate ascites and became so weak that she had to go to the hospital; but with rest in bed and arsenic she improved greatly. After leaving the hospital the subsequent history could never be traced.

Hematemesis likewise occurs with other diseases of the blood, such as pernicious anemia and the leukemias; but the blood examination is usually sufficient here to explain the situation. Purpura hæmorrhagica also belongs in the same group as a possible cause of vomiting of blood; but here there are other hemorrhages besides that from the stomach, into other mucous membranes as well as into the subcutaneous tissues. In all these conditions the problem is never simple, and before reaching a conclusion one must go carefully into the history preceding the hematemesis, as well as into the physical examination other than investigation of the blood itself.

V. Acute Pancreatitis. That hematemesis can form a very important symptom of acute pancreatitis has recently been called to my attention by the following case:

CASE IX.—A man, aged twenty-nine years, always previously well, was taken suddenly and violently ill on the evening of July 19, 1908. After his supper he had a feeling of weight in his stomach rapidly increasing to violent pain. This persisted until, one hour later, he vomited a large amount of "black-looking stuff;" this happened twice during the night, and he estimated there must have been a gallon of it altogether. Pain then ceased. During the next few days he had a moderate amount of pain at intervals; persistent nausea and vomiting, irrespective of food; obstinate hiccough, only relieved temporarily by stomach washing; a good deal of bloating and distention in the upper abdomen; but no fever of consequence. After July 25 there was no further hiccough or pain, but he continued to vomit, at least once every day, even though he was fed exclusively by the rectum. The vomitus consisted of thin material, dark brown in color. He was brought to my service at Lane Hospital on July 31 from his home in the country, when

the foregoing history was elicited. There he continued to vomit several times each day a dark brown material that tests showed to be altered blood. This vomitus was at times almost pure blood, with clots, and was profuse in amount. He was found to have a fulness and a palpable mass in his upper abdomen, especially in the epigastrium and right hypochondrium, quite tender to the touch. His temperature ranged from normal each morning to 101° each evening. His leukocytes ran as high at times as 35,000, and never below 21,000, with 84 per cent. polymorphonuclears. Because of progressive weakness and continued hematemesis an exploratory operation was done by Dr. Rixford on August 5. This revealed a large abscess behind the stomach in the folds of the gastrohepatic omentum, from which about eight ounces of pus were evacuated. The patient died on the 7th. Autopsy showed further that a large portion of the pancreas, between the middle and distal third, was necrotic and infiltrated with pus. There was no ulcer in the stomach or duodenum. The anatomical diagnosis was, therefore, acute suppurative pancreatitis, with perforation into the lesser omentum.

This was the first case I had ever seen of acute pancreatitis, but I have found since from the literature that vomiting of blood has been a prominent symptom in the other cases recorded. Of course, the disease is an unusual one, and, therefore, cannot be looked upon as a frequent explanation of hematemesis; in fact, the hematemesis is much more likely to be attributed to something else. In this particular case the condition was thought to be perforated gastric ulcer with localized peritonitis until operation and autopsy made clear the true state of affairs.

VI. *Uremia*. Can vomiting of blood occur as one of the consequences of uremia and chronic nephritis? The text-books have but little to say on the subject, though here and there the possibility is mentioned. In the following case the hematemesis could be explained in no other way. Possibly it was not a manifestation of uremia, but the autopsy showed no other reason for its occurrence. Before death it was supposed to be due to an aneurysm leaking into the œsophagus or to cirrhosis of the liver; but neither condition was subsequently found to exist.

CASE X.—A man, aged sixty-two years, was seen in consultation on May 5, 1908. He had never used alcohol to excess and never had syphilis or any previous disease. His illness began in October, 1907, with gradually failing strength, loss of appetite, weakness, and exhaustion. Later on he had severe headaches and was greatly annoyed by frequent urination. At one time he was troubled for several weeks by double vision, which he attributed to biliousness. He gradually lost forty-five pounds in weight between October, 1907, and May, 1908. On April 14 he had a very severe uremic convulsion, followed by unconsciousness for several hours. Subse-

quently he had numerous others, but less severe. On April 25 he vomited a quantity of dark blood, and after that repeatedly brought up varying amounts of blood nearly every day. His urine was persistently low in specific gravity, varying from 1005 to 1010, with a varying amount of albumin, hyaline and granular casts, and a low urea output. His arteries were all sclerotic. His cardiac impulse was violent and heaving and both visible and palpable over a wide area, not only in the precordium, but in the suprasternal notch, to the right and left of the sternum and as far to the left of the chest as the anterior axillary line; with a systolic murmur heard all over the heart, but most loudly over the upper sternum and the second right intercostal space, with sharp accentuation of the aortic second sound. There was no enlargement of the liver or spleen. The patient died on May 7. The autopsy showed both kidneys shrunken, nodular, and hard, with many hemorrhagic spots throughout their substance. The heart was greatly enlarged and dilated, with the mitral valve incompetent. The aortic arch showed areas of atheromatous degeneration, but no aneurysm. The œsophagus was normal throughout its entire length, except for some excoriation in the last two inches. The stomach was dilated, but no ulcer was present, or ruptured bloodvessel; there seemed to be only hemorrhagic weeping from the mucous membrane. The liver was congested and softened, but otherwise normal. The gall-bladder was distended with dark bile and contained numerous stones. The spleen was congested and friable. The pancreas appeared normal. No explanation was therefore found for the hematemesis, except the toxemia resulting from the kidney insufficiency.

VII. *Toxic Gastritis.* After the swallowing of any corrosive poison the gastritis resulting commonly leads to the vomiting of blood; but the history makes the explanation clear. I have seen one case of hematemesis associated with salivation, following the excessive use of mercury, in which a toxic gastritis was assumed to be the causative disease; but the patient recovered and anatomical proof was never secured.

CONCERNING DISEASES THAT DEPEND ON DISTURBANCES OF INTERNAL SECRETION.¹

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THE subject I have chosen to discuss today has to do with diseases which depend on disturbances of internal secretion. I have selected

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this theme because it represents one of the central points of interest in modern medical science, and because the Vienna Medical School has taken an active part in its development. I cannot, however, attempt an exhaustive presentation of the subject, since the time allotted permits me only to outline the most important clinical pictures; I must, therefore, confine myself to the most important interrelations between the various disorders of internal secretion and their relation to the nervous system.

I begin with two familiar diseases: The one is characterized by the appearance of a certain nervous irritability occurring in youthful individuals. A slight tremor of the extended fingers is noticeable, there is a tendency to profuse perspiration and frequent insomnia; exophthalmos develops, and is accompanied by the ocular symptoms described by Stellwag, von Graefe, and Möbius. In addition, there is increased pulse rate and palpitation. The physical examination often reveals enlargement of the heart. A usually diffuse swelling of the thyroid gland appears. Furthermore, the metabolism shows characteristic abnormalities. The amount of the respiratory exchange is, as is well known, largely dependent upon food intake and muscular activity. If we eliminate these two factors by examining the patient while fasting and at rest, the respiratory exchange is found to have a relation to the weight and size of the body. This so-called basic exchange is often markedly increased in the disease that I am now discussing. The same is true of the protein metabolism, that is to say, it is necessary to give more protein—the nitrogen-free substances remaining the same—in order to produce nitrogen equilibrium; furthermore, our investigations have shown that more carbohydrate is required in these conditions to depress the protein metabolism to a minimum. Accordingly, we find that such patients often lose weight in spite of increased appetite. In proportion to the augmented food intake we find the urine increased in quantity, in nitrogen-content, and specific gravity. It is important to note that in such patients the administration of even comparatively small doses of dextrose produces alimentary glycosuria. Finally, let me point out that diarrhoea often supervenes, and that, as the researches of our clinic have shown, the stools frequently contain a high percentage of fat. This group of symptoms constitutes, as is known, exophthalmic goitre, or Basedow's or Graves' disease.

In contrast to this there is a disease which is in many respects diametrically opposed. A peculiar mental and physical lethargy develops, which may progress even to psychic depression. The skin of the face and neck becomes puffy, the lips and eyelids become swollen, the facial expression often resembles that of a nephritic subject, the wrists and ankles swell, the skin grows dense and desquamates. Frequently dry eczema appears. The hair becomes brittle and falls out; the nails and teeth show trophic disturbances;

the beard and pubic hair remain absent. The pulse is slow and small. The patients have cold extremities and are easily chilled. Frequently there is constipation and tympanites. When this disease develops in young persons, growth is interfered with. X-ray examination shows a retardation of the calcification of the cartilages. Finally, we find that the metabolism is directly opposite to that of Graves' disease. Basic exchange and protein requirement are lower, and the administration of enormous quantities of dextrose causes no glycosuria, even when adrenalin is given simultaneously. To this disease the name of myxœdema has been given.

The cause of both these conditions is to be looked for in the thyroid gland. The connection between these two diseases and the thyroid gland has been recognized only in modern times. The investigations of Schiff, as well as the tragic results of total extirpation of the thyroid, first observed by Kocher, gave the stimulus for the exploration of this field. In individuals deprived of their thyroid gland a condition developed which resembled closely that of spontaneous myxœdema. This condition was called *cachexia strumipriva*. On the other hand, postmortem examination of the thyroid in myxœdema has shown degeneration of the gland. Congenital defect of the thyroid gland will also lead to a similar condition, known as *thyreo-aplasia*. In this group belongs also the cretinism often found endemic in goitre regions. We can regard as the cause of all these conditions the absence or insufficiency of the thyroid gland.

On the other hand, we find in Graves' disease a swelling of the thyroid. Microscopic examination shows a proliferation of the epithelium and increased vascularization: in short, signs of hyperfunction. In a similar manner we may explain the following symptoms, which appear in certain cases of goitre: These are increase of pulse rate, distinct enlargement of the heart, slight tremor, glistening eyes, and slight increase in metabolism, a condition which Kraus has named *goitre heart*. It is significant that the administration of thyroid extract may cause symptoms resembling those of Graves' disease, such as increase in pulse rate, excitability, and in animal experimentation even prominence of the eyes; furthermore, loss of weight, increase in respiratory exchange and protein metabolism, and alimentary glycosuria, symptoms which promptly disappear when the administration of thyroid is discontinued.

Before I pursue this subject further I wish to say a few words about the physiology of the thyroid. The thyroid gland represents the pure type of a gland with an internal secretion. It has no excretory duct, its secretion finding its way into the circulation probably by way of the lymphatics. The discovery of Bauman, that the thyroid contains iodine in organic combination, created considerable interest. Bauman isolated an iodine-containing substance called by him *iodothylin*, and Oswald showed, later, that

this substance is split off from an iodine-containing protein by the action of mineral acids. This protein he called thyroglobulin. Both investigators and many others regard these iodine-containing substances as the active principle of the thyroid gland. The only point on which their opinions are divided is, whether the thyroid gland removes from the circulation the iodine in order to build up its active principle, which is then secreted, or whether it employs this iodine-containing substance to neutralize within the confines of the gland toxic substances circulating in the body. It seems to me, however, that the significance of the iodine in relation to the thyroid functions is not yet definitely proved, and that it is possible that the active principle of the thyroid is not identical with the iodothyryn (von Fürth and Schwarz).

Be that as it may, the expressed juice of the thyroid or dried powdered thyroid contains the active principle, as is evident by the fact that their administration is capable completely of removing the effect of the absence of the thyroid function. In this manner we are able to cause the symptoms of myxœdema to disappear completely. The moment, however, that the treatment is interrupted the symptoms reappear, which is proof that the active principle of the thyroid is under normal circumstances constantly secreted. The fact that the thyroid administration is of no avail in most cases of cretinism is no proof to the contrary, because, as Kraus says, cretinism lies behind myxœdema; that is to say, the prolonged absence of the function of the thyroid has produced permanent changes in the tissues. In support of this are the findings of von Wagner, that in infantile cretinism the thyroid substance is still efficacious. In the animal experiment the state of affairs is the same. After extirpation of the thyroid gland the protein metabolism is also greatly depressed. Furthermore, we have found that in thyroidectomized dogs adrenalin does not cause glycosuria, and that its blood-pressure-raising action is diminished. Trophic disturbances as well appear. In some animals, for instance goats, real idiocy develops, and in cases in which the extirpation has been performed in early youth the development of the genital apparatus usually is arrested. All these results of thyroid extirpation may be counteracted by the administration of thyroid substance, but not of iodothyryn. A final link in the chain of evidence is furnished by the results of the surgeons: for cachexia strumipriva may be avoided by leaving a small part of the thyroid gland, and, on the other hand, Graves' disease may be practically cured by removing the greater part of the hyperfunctionating gland.

The development of this conception of the thyroid functions met with many difficulties; in fact, there are today still widely divergent views in regard to the subject. This is caused, in my opinion, by the apparent intimate relation between the thyroid and other glands of internal secretion, through which the clear outlines of the clinical

pictures are blurred. The disturbances in the function of the other glands is caused, on the one hand, by mechanical means (through proximity to the thyroid), and on the other hand, by chemical means, by which glands at a distance are affected.

One will no doubt have perceived that I have as yet omitted one of the results of the extirpation of the thyroid, namely, tetany strumipriva. This condition is characterized by the appearance shortly after operation of muscular spasm, fibrillary twitchings, and convulsions. There is also mechanical hyperirritability of the nerves (Trousseau and Chvostek signs), hyperirritability to the faradic current (Erb's sign), and parasthesia, especially upon pressure over the nerves (Hoffmann's sign). If the set of symptoms is complete, death may shortly ensue. A similar syndrome, though much milder, may occur spontaneously in epidemics. In Vienna and Heidelberg, particularly, such epidemics occur in the spring, affecting chiefly cobblers and tailors. Further, we observe a similar syndrome in pregnancy, in certain intoxications, in early infancy, and in patients with gastrectasia. This condition has nothing whatever to do with the thyroid gland. It is caused by failure or insufficiency of the parathyroid glands. The parathyroids are in many animals closely applied to, often even partially included in, the substance of the thyroid, and may thus unintentionally be removed with the latter. In this way symptoms caused by the removal of the parathyroids have been wrongly interpreted as the result of thyroidectomy.

We can produce the complete picture of tetany by extirpating or injuring the parathyroid glands. If, on the other hand, the parathyroids are not injured by the operation, and remain functionally entirely intact, extirpation of the thyroid gland alone will never produce tetany. Considerable light has been thrown upon the development of tetany in infants by investigations in Escherich's clinic in Vienna; at autopsy in such cases of infantile tetany hemorrhages within the parathyroids have been found. The conditions underlying tetany in cases of poisoning have been, to a certain extent, cleared up by the investigations of Rudinger. If we remove some of the parathyroids and injure the remaining ones, a condition of latent tetany develops; that is to say, true convulsions do not appear, but a condition of muscular hyperirritability, as can be demonstrated by the electric current, is produced. If, now, these animals are poisoned with such drugs as cause occasionally in man tetany-like symptoms, as, for instance, ergotin, this latent tetany is converted into regular tetany with convulsions. This suggests the conclusion that in such patients, in whom poisoning has caused a tetany-like condition, a latent insufficiency of the parathyroids exists. In spite of the fact that many points still remain to be cleared up, for instance, the fundamental etiological factor of the epidemic tetany of cobblers and tailors, it is not too much to say

that we may assume a common underlying cause, namely, insufficiency or a complete deficiency of the parathyroids in all the conditions and forms of tetany. This conception may be regarded as a triumph of modern experimental research.

What, then, are the relations between the thyroid glands and the parathyroids? On account of the close approximation of the parathyroids to the thyroid glands functional disturbances of the parathyroids may occur as a consequence of rapid strumous enlargement or inflammation of the thyroid gland. As a matter of fact, there are cases of Graves' disease and of myxœdema which show mild symptoms of tetany. However, the relations between these two glandular structures are somewhat more complicated. I have already mentioned the fact that in thyroidectomized dogs adrenalin does not cause glycosuria and that its blood-pressure-raising action is diminished. It now appears that when the thyroid and parathyroids are removed the action of adrenalin is increased rather than diminished. The glycosuria, which some observers report in thyroidectomized dogs upon feeding (Kraus and Friedenthal), or subcutaneous injection of dextrose (Underhill), is surely to be ascribed to the fact that these animals had tetany, because at the time of removal of the thyroid the parathyroids were either removed or injured. Now, sets of symptoms observed in conditions of hyperthyroidism point to a hyperirritability of the sympathetics; whereas, in conditions of hypothyroidism the sympathetics seem to be in a state of lessened irritability. If the parathyroids are removed with the thyroid, we obtain, on the other hand, a certain degree of hyperirritability. We may, therefore, assume that there is to some extent an antagonism between the action upon the sympathetics of the thyroid and the parathyroids; that the thyroid stimulates the sympathetics, while the parathyroids depress them, and thus the parathyroids are implicated indirectly in the production of the symptoms of myxœdema and thyroid aplasia by the preponderance of inhibitory impulses. As regards an explanation of tetanic convulsions, I wish merely to suggest that under normal circumstances inhibitory impulses are constantly sent from the parathyroids by way of the sympathetics to the motor ganglia of the cord and the cranial nerves. If these impulses are stopped by the extirpation of the parathyroids, a condition of heightened irritability of these ganglia, together with their peripheral nerves, would result, the most extreme degree of which would be convulsions.

I now turn to the consideration of two glands with internal secretion that are of great significance, especially in regard to carbohydrates. These are the pancreas and the chromaffin system. It is well known that extirpation of the pancreas in animals produces a severe and fatal diabetes. We may assume that the pancreas has an internal secretion which causes the oxidation of carbohydrates into carbon dioxide and water. It has been suggested that the

islands of Langerhans, groups of cells distributed throughout the pancreas and easily demonstrable under the microscope, represent the seat of origin of the internal secretion. Of the same importance for the carbohydrate metabolism is the chromaffin organ. This term is applied to all cells, partly in the medullary portion of the suprarenals and partly scattered throughout the entire sympathetic nerves, which are characterized by their affinity for chromic salts. The chromaffin substance which these cells contain is adrenalin. Schur and Wiesel, in Vienna, have pointed out that these cells, as a result of extreme muscular activity, lose for the time being their chromaffinity; that is, their adrenalin is consumed. Furthermore, they found that the amount of adrenalin in the blood serum during severe muscular exertion is increased. During muscular activity a large amount of glycogen is melted down. Schur and Wiesel suggest, therefore, that this process of melting down of glycogen is caused by the action of adrenalin, and that in general the mobilization of carbohydrates in the animal body is regulated by the chromaffin organ. It is exceedingly probable that the glycosuria observed after intravenous or intraperitoneal injection of adrenalin depends upon a too rapid and excessive mobilization of carbohydrates.

Numerous investigations of Rudinger, Eppinger, and I, into the discussion of which I cannot enter here, have now convinced us that there exists a sensitive regulating mechanism between the action of the chromaffin system, which governs the mobilization of carbohydrates, and the action of the pancreas, which causes their oxidation; so that under normal circumstances mobilization and oxidation keep pace with one another and the sugar content of the blood is maintained at the normal level. Furthermore, our investigations have shown that there is a certain antagonism between the pancreas and the thyroid gland. The thyroid gland exerts an inhibitory action upon the pancreas, and vice versa. The extirpation of the thyroid gland results, therefore, in a relative hyperfunction of the pancreas, and, vice versa, an increased function of the thyroid gland produces a relative insufficiency of the pancreas. In this manner two facts, mentioned above in connection with diseases of the thyroid, are made clear to us: In thyroidectomized dogs adrenalin produces no longer glycosuria; furthermore, in cases of myxoedema enormous quantities of dextrose may be ingested without producing alimentary glycosuria, even when small doses of adrenalin are injected. In these cases the action of the pancreas is increased, larger quantities of its internal secretion are in circulation, so that even a surplus of mobilized sugar can be oxidized. On the other hand, in a state of hyperthyroidism, for instance, in Graves' disease, there is a relative insufficiency of the action of the pancreas, and therefore alimentary glycosuria is in this disorder often very easily produced.

In this connection I should like to say a few words about human

diabetes. In a number of cases of severe fatal diabetes postmortem examination of the pancreas has shown no lesions. If we compare the symptoms of diabetes in dogs, whose pancreas has been removed, with the symptoms of the genuine human diabetes, we find important differences. I need merely mention the fact that in human diabetes the production and excretion of sugar in proportion to protein metabolism may be much larger than in the experimental diabetes; that the protein metabolism, in spite of the enormous sugar waste, is not increased, whereas dogs with experimental diabetes consume the threefold quantity of protein. All these facts point to the conclusion that human diabetes is not dependent solely upon disease of the pancreas; indeed, it is my belief that in many cases besides an insufficiency of the pancreas, there exists a primary increase of the carbohydrate mobilization by means of a hyperfunction of the chromaffin system. The etiology of the latter is as yet quite unexplained. I can only call attention to analogous conditions in the external secretions, such as hypersecretion of gastric juice, which has so far never been demonstrated to be associated with definite pathological lesions.

The suprarenals, as is known, are associated still with another condition, known as Addison's disease. Considerable difficulty is met with in deciding which of the symptoms of Addison's disease are referable to disease of the cortex or disease of the medullary portion of the suprarenals. Undoubtedly lesions of the chromaffin system—the cortex of the suprarenals not being affected—may lead to a set of symptoms resembling those of Addison's disease; on the other hand, we know that the removal of the cortex alone in animals causes death after intense prostration. It is therefore to be expected that the cortex also produces a substance which, as well as adrenalin, is of vital significance to animal life.

There remains the consideration of the significance of the internal secretion of the genital glands and of the hypophysis. The internal secretion of the genital glands is undoubtedly of great importance. The lessened desire for physical activity, accompanied by an increase in adipose tissue, in castrated animals, is well known; the psychic alteration during pregnancy and the climacterium, the enlargement of the breasts during pregnancy, etc., are equally well known. In regard to the last point, Starling's results are of great interest. He obtained a cactostabile substance from the ovaries which, when injected into non-pregnant animals, caused enlargement of the breasts and lactation. The ovaries evidently have some relation also to the thyroid, for in pregnancy one sees occasionally enlargement of the thyroid gland, accompanied by mild symptoms of Graves' disease, such as palpitation, increased pulse rate, etc.

As regards the hypophysis, the set of symptoms designated as acromegaly is well known. I shall pass over the ocular symptoms, such as bilateral hemianopsia and optic nerve atrophy. These are in all

probability results of pressure of the growing hypophysis upon the chiasm; but the alteration observed in the soft parts, such as enormous enlargement of the nose, the lips, the tongue, and the extremities, is undoubtedly the consequence of a derangement of the internal secretion of this gland. It is only fair to state that certain authors interpret this in the opposite way; that is, that the enlargement of the hypophysis is simply an expression of the same cause as produces the hyperplasia. Personally, this latter view seems to me to rest on slight foundation. Of great interest is the very recently published statement of Erdheim and Stumme, that the slightly swollen face occasionally observed in pregnancy is accompanied by slight increase in the size of the hypophysis. These facts show evidently a relationship between the genital glands and the hypophysis. Although little is certain in regard to the influence of the hypophysis upon the growth and internal metabolism, it seems to me highly probable that the set of symptoms found in acromegaly is dependent upon a hyperfunction of the hypophysis, just as the symptoms in Graves' disease are dependent upon hyperfunction of the thyroid gland. A certain similarity seems to exist between the hypophysis and the thyroid gland in their relations to the pancreas, for we find in the majority of cases of acromegaly disturbances of the carbohydrate metabolism—even severe diabetes.

There is, finally, a condition which may be justly conceived as dependent upon a hypofunction of the hypophysis. There have been observed, indeed, cases of slow-growing cancer of the hypophysis, in which a considerable part of the gland has been destroyed. In these cases there develops a set of symptoms first described by von Frankl-Hochwart and Froehlich. The small number of cases (so far on record) are all in youthful individuals, who had not attained their full growth. As the tumor increases, the same ocular pressure symptoms, as mentioned above under acromegaly, develop. The symptoms which interest us chiefly, however, are the increased obesity, a pasty swelling of the face, stop in genital development, disappearance of pubic and axillary hair, and impotence. Von Eiselsberg has operated upon two such cases. It is extremely interesting that the removal with enough of the tumor to relieve the pressure upon the still healthy part of the gland has caused the disappearance of some of the symptoms. The axillary hair began to grow again, and erections also recurred. If we remember now that pregnancy may produce enlargement of the hypophysis, and that insufficiency of the hypophysis may result in a lowering in the activity of the genital glands, we cannot but recognize that a mutually helpful relationship exists between these two glands.

Let me then recall, in addition to the foregoing, the other relationships previously mentioned. These are relations between the thyroid and the genital glands, between the thyroid and the parathyroids, and between the pancreas, on the one hand, and the para-

thyroids, hypophysis, and chromaffin system, on the other. I believe this will suffice to illustrate how very complicated are the relations between those various glands.

In what manner shall we conceive this action of one gland upon another to take place? It is possible that the internal secretion of the one gland reaches the other by means of the circulation, and thus either increases or inhibits the latter's activity, or that it either increases or decreases the efficiency of the internal secretion of the gland, or that in certain regions of the central nervous system it produces impulses or inhibits existing impulses, and thus indirectly influences the secretory cells. The time will not permit me to enter into this very difficult subject, and I shall therefore confine myself to the following considerations: A portion of the nervous system, as is known, governs principally the vegetative functions; another, the functions of the heart, of the intestines, and the metabolism. Since glands of internal secretion control the internal metabolism, it is to be expected, *a priori*, they will control also these portions of the nervous system. This is, indeed, a fact. Among the symptoms of hyperthyroidism the majority point to a hyperirritability of the sympathetic nerves. So, also, adrenalin exerts its chief influence upon the nerve endings of the sympathetic system. So, too, puncture of the medulla causes glycosuria probably by stimulating the cells of the chromaffin system to an increased secretion of adrenalin. The mechanism, then, I conceive to be, that a period of excitation is established in the nerve centres of the fourth ventricle, from which impulses are sent by way of the splanchnic nerves to the chromaffin system. On the other hand, we observe that the internal secretion of the pancreas is associated with the tonus of the autonomous vagus. Important facts indicate that certain drugs which have a stimulating effect upon the vagus increase the internal secretion of the pancreas. One sees, therefore, that the interaction of the glands of internal secretion is paralleled by the relation to the sympathetic nervous system; finally, that there are relations with the muscular apparatus is evidenced by the excessive hyperirritability of the motor neuron, which results from failure of the parathyroids.

The careful study of the cases belonging in this group of diseases does not suffice for the exploration of this subject, even when the autopsy augments our records. The reason for this, in my opinion, is that the glands of internal secretion form, as the numerous close inter-relationships of these glands suggest, a connected organic system. It is, therefore, to be expected that just as is the case in the hematopoietic system, a pathological process which becomes established in one part of the system will also cause disease to a greater or less extent in the rest of the system, and therefore mislead the clinician. From all of this one sees the great value of animal experimentation, in which we may control conditions at will. It is

especially with the growth of the antivivisection movement in this country in mind that I wish to emphasize the fact that animal experimentation has been of overwhelming significance in the investigations of these diseases, and that it has chiefly contributed to the blessings which result from the scientific treatment of many of them.

THE TREATMENT OF ACUTE INFECTIOUS DISEASES WITH EXTRACTS OF LEUKOCYTES (HISS).¹

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THE promulgation of a new method of treatment in any disease carries with it in these days of therapeutic skepticism the burden of proof that there is anything in it which is worthy and deserves to last. Such an event has recently taken place and a new phase of the general problem of immunity has been advanced by Professor Hiss, and a scheme for its therapeutic application to a whole group of diseases has been developed in his laboratory at the College of Physicians and Surgeons. When the College of Physicians of Philadelphia asked me to present something to the section on General Medicine I decided to bring to you this new method of treating acute infectious disease by leukocyte extracts, because its clinical application has been worked out in part in the hospital services over which I have the good fortune to preside, and because, though it is still in the experimental stage, I believe that a presentation of its present development even though incomplete will interest you. I propose to devote myself largely to the clinical aspects of my thesis and to discuss theory only so far as may be necessary to explain the method and the results obtained.

Professor Hiss approached this subject entirely from the theoretical and laboratory side, and worked out his method upon the basis of animal experimentation. The laboratory development has, therefore, reached a higher plane than has its application to the diseases of man. In general, the method consists of the subcutaneous injection of an aqueous extract of dead leukocytes taken from rabbits. The leukocytes are secured in a bacteria-free condition from the pleural cavities of the animal under the stimulus of the injection of aleuronat. These exudates are centrifugalized and washed free from serum with saline solution and then extracted with an amount of distilled water equal in bulk to the original amount of the exudate.

¹ Read by invitation at a meeting of the Section on General Medicine of the College of Physicians of Philadelphia, January 11, 1909.

The remedy used in all the cases of disease in man has been this aqueous extract of rabbit leukocytes, although a similar preparation from other animals (dog) was also used in laboratory work. In most cases the leukocyte extract was made from normal rabbits, but in a few cases, prior to the injection of the aleuronat, the rabbits were immunized to the bacterial cause of the disease to be treated. With this occasional exception the same remedy was applied to all the infectious diseases treated irrespective of the causative agent, for the effect of the remedy is on the toxins of the bacteria and not on the bacteria themselves. The effect is to neutralize the toxins and to assist this action of the patients' leukocytes which can meanwhile be increasingly busy in their phagocytic action. The patient is thus protected against the bacterial poisons pending his own action to destroy the bacterial cause of the disease. The fundamental nature of Professor Hiss' work from the therapeutic view point is found in this one fact that a single antitoxic animal product can influence the toxemia of a number of bacterial causes of disease.

This new method of therapy has been tried in my wards in cases of meningitis, pneumonia, ulcerative endocarditis, and malaria, and in other services in cases of chronic furunculosis, acute erysipelas, and other forms of septicemia. It has been found to influence the course of most of these diseases in a marked manner, but in varying degrees in different diseases and in different cases of the same disease. It is not a cure-all, but it offers a new help in antibacterial medication which is applicable to any case prior to the establishing of an exact bacterial diagnosis. Before giving the details of the results in individual cases I would state that this remedial method has been subjected to the severest clinical test that was possible. Those patients who presented a type of disease with evident mild infection and with symptoms indicating a good prognosis were, as a rule, not treated with these leukocyte extracts. But these injections were given in large degree to the patients who were evidently severely ill. The results are to be judged from the study of the symptomatology and the daily course of the cases, fully as much as from the mortality statistics of the cases treated. In fact, the number of cases treated is as yet too small from which to draw any final conclusions whatever.

Four cases of epidemic meningitis occurred in my service while this method of treatment was in use. They have already been included in Dr. Hiss' publication and statistics on this disease. Of these cases, three recovered and one died.

CASE I.—A girl, aged nine years, was admitted on the second day of the disease, after a sudden onset with vomiting, chill, fever, headache, stiff neck, and delirium. The temperature was 103.4°, the pulse 160, and the respirations 32. The leukocytes were 30,600 (polynuclears, 88 per cent.); and meningococci were present in the

spinal fluid. Ten c.c. of leukocyte extract was given on the day of admission and thereafter each day or at two-day intervals until twelve injections had been given. The patient improved and was discharged cured on the forty-ninth day.

CASE II.—A girl, aged eleven years, was admitted on the third day of the disease, with a history of headache, vomiting, delirium, and stiff neck. The temperature was 101° , the pulse 100, and the respirations 20. The leukocytes were 29,000 (polynuclears, 91 per cent.); meningococci were present in the spinal fluid. The case was under observation for twenty days, with gradual failure in the general condition and an irregular temperature. On the twentieth day of the disease treatment was begun with an injection of 10 c.c. This injection was repeated on the twenty-first day and again on the twenty-third day. The temperature remained normal after the second injection and the child gradually improved, and was discharged cured after thirty-six days of hospital care.

CASE III.—An infant, aged seven months, was admitted with a history of ten weeks of illness and fever. Two days before admission vomiting and convulsions occurred and had been repeated. On admission the temperature was 103.6° , the pulse 126, and the respirations 40. The neck was rigid and the spinal fluid contained meningococci. The child's temperature became normal, but she continued emaciating, with extreme stiffness of the neck and extremities and constant vomiting. The first injection, made on the forty-seventh day of the disease, was of 10 c.c.; the injection was repeated daily, or every other day, usually in doses of 5 c.c., until a total of 50 c.c. was given. The general condition improved, the child began to take food, gained weight, and was finally discharged cured on the one hundred and thirty-eighth day.

CASE IV.—An adult, aged twenty-five years, was admitted on the second day of the disease, complaining of headache, general pains, and vomiting. The temperature was 99.2° , the pulse 92, and the respirations 22. There was a general hemorrhagic eruption, the patient had a rigid neck; and meningococci were found in the spinal fluid. The leukocytes were 21,000 (polynuclears, 93 per cent.). The patient died on the thirteenth day of the disease in spite of daily injections of 10 c.c., and there was no evidence of improvement while taking the treatment.

The treatment was tried in one case of pneumonia which ended fatally, and which was proved by autopsy cultures to be due to Friedländer's bacillus. The case showed a distinct increase in the number of leukocytes after each injection and some drop in the temperature curve, but the toxemia was extreme and there was no permanent change in the course of the disease or in the severity of the infection.

An equally severe test was that of an elderly woman, aged eighty-four years, who developed a sudden illness with cough, fever,

cyanosis, and dyspnoea. On the third day there was an evident consolidation in the right upper lobe, the temperature was 103° , the pulse feeble, the patient was quite cyanosed on coughing, and a fatal termination seemed inevitable. Three injections of 10 c.c. of the extract were made on three successive days. The patient improved at once after the first, and the second was followed by a fall in the temperature to normal, where it remained and the patient recovered. In this case no bacterial diagnosis was attempted.

Professor Hiss reported some 8 cases of lobar pneumonia which were treated and all of which recovered. But there was no remarkably striking result and no change in the ordinary length of the disease. A systematic study of a large number of cases of pneumonia has not been undertaken.

The treatment has been tried in a number of cases of a more general infection with the pneumococcus. These have included cases of cerebrospinal meningitis and of ulcerative endocarditis of pneumococcic etiology. The cases of pneumococcic meningitis showed distinct febrile remissions after the injections, but neither of two cases recovered, nor did any evidences of a real betterment in general condition appear.

The three cases of ulcerative endocarditis which have been treated by this method have not proved particularly amenable to the injections. Two cases were due to the pneumococcus which was recovered from the blood. In the third no living organism could be demonstrated by culture from the blood. In one case the temperature before the injection ranged from 101° to 103° . After the injection of 130 c.c. of the extract in thirteen doses the temperature ranged for a few days between 100° and 102° upon a slightly lower plane. At this stage of the disease the patient developed a consolidation of the left lung and died with all the evidences of cerebral embolus and paralysis of the left side of the body. In the case of negative blood culture the injections did not seem to be of any influence either on the course of the fever curve or on the final result. The patient died of cardiac depression shortly after the treatment was given.

The third case was that of a man, aged forty-seven years, who had been ill four months with gradually increasing weakness and chills at irregular intervals during that time. He suffered from evidences of cardiac disturbance: palpitation of the heart, shortness of breath, and dizzy feelings. During these four months he lost forty-five pounds, had night sweats, and suffered from sleeplessness. He was admitted with a temperature of 101° , a pulse of 88, and respirations 24. His leukocytes were 11,900 (polynuclears, 81 per cent.). Examination of his heart showed a systolic murmur loudest over the pulmonary area and heard over the whole left half of the precordium. He had petechial spots on his legs and right forearm and in his conjunctiva. A blood culture gave a pneu-

mococcus of lowered virulence but in pure culture. The course of the disease for five days was about the same on each, the pulse ranged from 90 to 100, the temperature from 101° to 103° , and the patient's condition seemed stationary. Leukocyte extracts were begun after six days of observation. These were given daily, sometimes twice daily, and once three times from the seventh day of observation until the seventeenth. During this time his temperature would vary from 100° in the morning to 102° or 103° in the afternoon. The patient in this period received 220 c.c. of extract of leukocytes from normal rabbits, 40 c.c. of leukocyte extract from rabbits immunized against the patient's own brand of pneumococcus, and 18 c.c. of a true antitoxic serum from pneumococcus-immunized rabbits. The leukocytes increased up to 13,000 and the polynuclear cells remained about 86 per cent. His hemoglobin on admission was 65, and at the end of this time had fallen to 45 per cent. His red cells had fallen from 4,800,000 to 3,800,000. The patient developed after this course of treatment an urticaria, and treatment was suspended for three weeks. No special change was noted during this time in the patient's condition. The temperature ranged irregularly, the pulse became rather rapid, ranging from 120 to 140, the patient developed emboli in the right lung, giving rise to several small infarcts, and his condition was distinctly downhill. After being in the hospital for five weeks his leukocytes were 17,800, his polynuclears 81 per cent., his red blood cells 3,800,000, and his hemoglobin 40 per cent. It could be said that the leukocyte extracts had modified his disease in any particular. At this point the injections were resumed and the course of the case showed some slight changes in the run of the temperature. For a short period the remissions were greater, the pulse rate was somewhat slower, and the patient seemed less ill. A second blood culture taken at this time showed the same positive cultural result as before, and the patient grew slowly worse. He developed a general petechial eruption, evidences of extensive infarctions appeared in his lungs, and he died of his toxemia.

Of all the infectious diseases, acute ulcerative endocarditis must be looked upon as the most difficult to modify by treatment. It has necessarily been considered a fatal disease, and will always be considered as the supreme test of any remedy which is suggested.

The influence of leukocyte extracts on febrile disease was perhaps most markedly shown in a case of tertian malaria. The patient was an adult, aged thirty years, and was admitted with a history of having had severe chills, at first every other day, and later daily. The patient had been taking quinine irregularly for six months. A physical examination showed an enlarged spleen one and one-half inches below the ribs. Her other organs appeared normal. The admission temperature was 98.4° , but upon the afternoon of the day of admission the patient had a chill and a rise of temperature

to 104° , which rapidly fell until, the next morning, it was 97° . A second chill with a rise of temperature to 106° followed on the second afternoon. Plasmodia of the tertian variety were present in large numbers in the blood. White blood cells ranged from 5400 to 7000, and there was a relative lymphocytosis. Immediately following this second chill the patient received 10 c.c. of leukocyte extract. This was repeated twice on the day following and once on the day after that; the patient's temperature on the third day of observation was 98.4° in the morning, 100.8° in the afternoon. On the fourth day it was 99.2° in the morning and 102.2° in the afternoon. On the fifth day it was 98.4° in the morning and 102.4° in the afternoon. On the sixth day it was 98.8° in the morning and 103.8° in the afternoon.

During all this time there was no treatment; the plasmodia continued, on daily search, to be present in the blood in large numbers. There were no chills and the patient felt perfectly well, except for the tenderness over the points of injection. The next day she received another dose of leukocyte extract of 10 c.c. Her morning temperature was 98.4° , her evening temperature 100.4° . The next day her morning temperature was 98.4° , her evening temperature 103° . She received a sixth dose of the serum. On the next day her temperature ranged from 98.4° to 100.8° . The day following it was 98.4° in the morning and 103° in the evening; the next day the same, 98.4° and 103° , with plasmodia present. The day following, the patient had a chill, the temperature rose to 104.4° , and the day following this was repeated, the temperature rising in the afternoon to 104° . The patient became restive under the treatment, she was given quinine, 5 grains every four hours, and her temperature did not rise again. The interesting feature in this case is the absolute control for short periods of time of the toxic symptoms in a case of double tertian malaria by an injection of leukocyte extracts. The disease returned rapidly, however, and went on its usual course until cured by quinine. Two further cases of malaria have been treated, but the results did not tally with the above. It was not possible to check the course of the chills in either one.

The effect on typhoid fever has not been carefully tested. It is evident, however, from a few experimental injections that these leukocyte extracts alone will not modify the course of that disease, and further experiments are necessary. The laboratory indications are favorable to the hope that some modification may develop a proper method of procedure in typhoid cases, but the characteristic polymorphonuclear leukopenia of typhoid fever may explain the absence of effect on the toxemia of the disease.

The most brilliant result of this treatment was found in the group of the pyogenic cocci. The treatment of local lesions of the skin was attended with striking results in a series of six cases of recurring

boils in the course of a chronic furunculosis. The cessation of the eruption promptly in all of the six cases treated was an index of the curative effect. All six cases were infections with *Staphylococcus aureus*, and two had been of several years' duration. Two other cases of chronic acne without pustule formation showed distinct improvement in the local lesion from a short course of treatment.

Perhaps the most remarkable results were obtained in a series of cases of erysipelas.² The following two cases show two types of the effect from the leukocyte extracts: In one the treatment was begun on the tenth day in a very toxic man and was continued by injections on four out of five days. Each treatment was followed by a fall in temperature, by an improvement in the patient's comfort, and by a normal fever curve after five days. The second case came under treatment on the second day of the disease with a temperature of 105° and a typical erysipelas of both eye regions, cheeks, forehead, and one ear. The eruption had some blebs and a red raised border. After one injection the temperature fell to normal, but the rash extended and a second injection completed the cure.

The following case of otitis media, complicated by mastoiditis and thrombosis of the jugular vein, was treated by the leukocyte extract, beginning after ten days of severe septicemia. The patient, a woman, married, aged thirty-one years, was admitted to the Manhattan Eye and Ear Hospital, on November 12, suffering from otitis media; puncture of the left ear drum was followed by a profuse purulent discharge. There was tenderness over the mastoid on admission. On November 14 a simple mastoidectomy was done, and at the operation a small area of sinus but no dura was exposed. November 15, the patient complained of pain in the right ear; the temperature was 102°. The membrane was bulging and was punctured; a purulent discharge followed. During the next four days the temperature ran a septic course, wavering between 105° and 101°. On November 17 the face was swollen, with marked redness. On November 18 œdema of scalp developed on the left side. On November 21 an exploration of the sinus showed it to be collapsed and the jugular vein thrombosed. A resection of the jugular vein was done. The temperature was running a septic course between 104° and 100°; 10 c.c. of leukocyte extract was injected on the 22d and the 23d. The temperature gradually came down, and did not rise above 102° on November 24 and 25. In the evening of November 25 the temperature again rose to 104°. The physician in charge omitted the treatment with the extract, thinking the case hopeless, but the patient nevertheless held her own for several days, and 20 c.c. of leukocyte extract was injected on November 28. A gradual

² These cases will be reported by A. V. S. Lambert in the immediate future.

improvement followed and the temperature became normal by December 3, where it remained, and the patient recovered.

The theoretical basis of this method of treatment was conceived by Professor Hiss upon the following argument: Contrary to the assumption of Wright that the phagocytic power of the leukocytes depends entirely upon the opsonins in the serum, Hiss observed that the phagocytic power of the white blood corpuscles varied in normal and in infected animals independently of the opsonic contents of the serum and in such a way that it was probable that this phagocytic power was depressed during the early stages of an infection and up to the height of its development and was increased as immunity became established and a cure resulted. Upon this basic observation as a premise Hiss inferred that in some diseases immunity depends upon the activities of the purely cellular elements of the blood independently of the serum. It is a fact also that animals survive repeated larger doses of germs because they develop, under the stimulus of repeated infections, both an increasing power of serum (antitoxins) and an increasing power of phagocytosis, and in addition an increasing power of neutralizing toxins. He inferred that some of this increasing power to neutralize toxins is an intracellular neutralization of the toxins set free from dead bacteria within the phagocyte cells quite independently of the antitoxic bodies of the blood plasma, which are known as antitoxins, agglutinins, precipitins, bacteriolysins, etc. He inferred then that there exists a kind of immune agents which are distinct from those of the plasma and which remain in the cells for cell protection alone, and are only seldom given off into the plasma. He inferred that these intracellular neutralizing bodies act upon the poisons liberated from the germs after these bacteria have died in the processes of phagocytic digestion. Such poisons are known as endotoxins, and Professor Hiss would name his theoretical neutralizing bodies of the leukocytes as "endo-antitoxins."

On these theoretical grounds Professor Hiss has established this method of therapy by which he hopes to aid the leukocytes in their combat with the bacteria by adding to the blood plasma the very substances which they elaborate and employ in the struggle. Professor Hiss would direct the method against those endotoxin-forming microorganisms against which no immune sera in the ordinary sense have been found to be efficient. This theory of the existence of an immunity due to non-diffusible endo-antitoxins formed and retained within the leukocytes must cause one to modify a semi-popular idea of the white blood cell as the warlike fighter of the animal economy, and must lead to a new conception in pathological cellular biology that the leukocyte is not an altruistic cell rushing to its death for the good of the greatest number, but it is a selfish protector of its individual existence which continues to live as an individual and as a "species" upon the broad laws of natural selection and of the survival of the fittest.

The diseases caused by infection with the various pyogenic cocci, both staphylococcus and streptococcus, are all diseases whose symptoms depend, in part at least, upon endotoxins. The same is true of typhoid fever, of epidemic meningitis, and of pneumonia. The chief diseases with soluble toxins which have come under observation in man are tetanus and diphtheria, and in these only can we hope to establish a true antitoxic serum. The attempt to form a polyvalent serum for the endotoxin diseases has also not been universally successful. And in general it has not been possible to secure a serum against the individual germ of any given case, because of the time required for the immunization of an animal. It would seem, therefore, that the theories of Professor Hiss have opened up a new field for antibacterial therapy which should be searched for new applications and subjected to an extended study. Professor Hiss has used in most of his experiments leukocyte extracts from normal rabbits, but in a few cases he has endeavored to produce an immunity against the general group bacteria which he is fighting, and to use leukocyte extracts from these partially immunized rabbits. In a few cases running a chronic course he first endeavored to immunize the animals against the germ secured by blood culture or otherwise from the patients before manufacturing the leukocyte extract from those animals. This has been attempted, for instance, in the case of ulcerative endocarditis cited above, but, as has already been shown, the endocarditic cases, as might be inferred a priori, have been particularly resistant to both kinds of extracts.

The result of the animal experimentation which Dr. Hiss carried on showed that the leukocyte extracts from normal rabbits could protect rabbits infected with lethal infections of various bacteria. Extensive experiments have been made on *Staphylococcus aureus*, on pneumococcus, on streptococcus, on meningococcus, and on typhoid bacilli. In all cases the effect was greater the earlier the beginning of the treatment. The same leukocyte extracts from normal rabbits cured guinea-pigs of infections universally fatal in control animals, so that the change in the species of the animal from that of the source of the leukocyte extract did not change the results of the experiments. So far as any inference could be drawn from the use of leukocyte extracts from immunized rabbits, it was found that this product had greater power than the extracts from normal animals. In the animals treated with leukocyte extracts it was found that the growth of bacteria was not directly inhibited by the treatment, nor was there evidence of an increased phagocytosis. The remedy, therefore, is neither bactericidal nor bacteriolytic, nor is it stimulating to the phagocytes. Its use in animals is usually followed by an increase in the polymorphonuclear leukocytes, and it seems justifiable to infer that its action has to do entirely with the neutralization of the bacterial endotoxins.

The following general conclusions seem to be justified: We have a new remedy representing a new point of view in the study of immunity, proving an endocellular immunity in addition to the accepted types of serum immunity and of phagocytosis. This remedy is applicable to obscure cases of unknown bacterial cause, to cases of disease with unknown or unapproachable lesions. The remedy influences the toxemia of the disease and gives an opportunity to the body cells to overcome the infection by removing from them the necessity of immediately attacking the endotoxins of the bacteria. It is by no means a "cure-all." It does not cure every case and it produces no miracles. It will not remove death from the world. In application it is painful locally, but it has caused no other local complication, and the urticaria so often seen in the use of serum has been conspicuous by its absence.

Finally, I would apologize for rushing forward with such a new and unproved theory of therapeutics, except that it seems justifiable to make known the fact that a new discovery is ready to be put on trial and to be thoroughly tested by many observers. Whatever is good in it will last, and whatever cannot stand this test of modern universal investigation cannot be worthy to endure.

THE RÖNTGEN-RAYS IN THE TREATMENT OF DEEP-SEATED MALIGNANT DISEASE.

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As the title indicates, the epitheliomas or superficial carcinomas will be omitted from consideration in this paper. The superiority, though not infallibility, of this therapeutic agent, I think, is well recognized in the treatment of superficial carcinomas. Its value in the treatment of deep-seated malignant disease is not so well recognized. By a few persons it is declared useless, while by others it is lauded as a cure. It is the object of this paper to arouse a discussion which will determine, as nearly as possible, its true status. The arguments which I present are based almost entirely upon personal observations made in the treatment of 35 sarcomas and 304 deep-seated carcinomas.

I have classed as deep-seated those cases in which the subcutaneous, glandular, visceral, or osseous tissues were involved. For the most part, the cases were recurrent, very advanced, or very malignant. As a whole, the cases are those that have passed beyond the reach of other forms of treatment. Therefore the Röntgen-rays

were used as a last resort, and while there has been ultimate failure in the majority of cases, some lives have been saved or much prolonged, and in nearly all there was some temporary benefit.

SARCOMA. At the annual meeting of the American Röntgen-ray Society, October 26, 27, 28, 1907, I presented a review of the work done by myself and others in the treatment of sarcoma by means of the Röntgen-rays¹. At that time I reported details of 22 cases treated by myself. Of these 22 cases, 11 had recovered and 4 more were recovering. On May 7, 1908, I reported at a meeting of the American Therapeutic Society the subsequent results in these cases, and added details of seven other cases.²

The cases of sarcoma that have come under my care have consisted almost entirely of those that were beyond any other form of relief, and therefore the recoveries are pure gains and just so many lives saved or prolonged. They were nearly all inoperable or recurrent, and the only other treatment that could be considered is the use of Coley's toxins of the streptococcus and *Bacillus prodigiosus*. Coley has obtained good results in 10 per cent. of his cases. My results show recoveries in over 50 per cent. of the cases. Fortunately there seems to be no reasonable objection to combining the toxins with the Röntgen-rays in the treatment of these inoperable cases of sarcoma. This I have done in four cases, but am not yet able to draw any definite conclusions. I believe that much skill is required in the use of the toxins. All acknowledge that much skill is required in the use of the Röntgen-rays.

Permanency of Results. The results cannot be properly appreciated unless the details of the cases are considered. I shall review in as few words as possible the results in 35 cases. In each case in which the type of cell is mentioned, and when not otherwise designated, the pathological examination was made by the surgical pathologist of the Medico-Chirurgical Hospital, under the direction of Professor Joseph McFarland.

CASE I.—A sixteen-year-old girl, referred by Dr. L. W. Fox, December 5, 1903, developed a small round-cell sarcoma involving the left orbit. At the beginning of treatment she was not expected to live a month. She recovered after three months treatment without damage to the eye. She remained well four months, when, following a slight operation upon the nose, she developed a rapid and an extensive recurrence and died.

CASE II.—A young man, aged twenty-one years, referred by Dr. W. L. Rodman, December 11, 1905, had developed a round-cell sarcoma at the angle of the jaw which grew to the size of an apple in four weeks' time, and was then excised. It recurred to the same size in four weeks, and was again excised. On the fifth day after

¹ New York Med. Jour., December 21, 1907.

² Therapeutic Gazette, July 15, 1908.

the second operation it had again recurred to half the size of a hen's egg, when he was referred to me for treatment. He was given twenty-two treatments in five weeks. Since then he has had no treatment, and is still well nearly three years later.

CASE III.—A young lady, aged thirty years, referred by Dr. E. B. Gleason, September 5, 1904, had developed a round-cell sarcoma involving the frontal, ethmoid, and maxillary sinuses. A section had been removed and examined by the pathologist of the Chester Hospital. She has been given to date 416 treatments. She has lived and has been quite comfortable for four years. She returned to her occupation as a milliner two months after beginning the treatment, and has continued to the present time. The tumor, as shown by a series of röntgenograms made at intervals, has nearly disappeared.

CASE IV.—A young girl, aged eleven years, was referred by Dr. Wm. L. Rodman. She had a small round-cell sarcoma involving the frontal and ethmoid cells. She was given thirty-one treatments between January 29 and April 18, 1907. Since then, a year and one-half, she has remained well.

CASE V.—Mrs. E. P., aged thirty years, was referred by Dr. W. W. Babcock, November, 1906. She had undergone three operations upon the right forearm for round-cell sarcoma and recurrences. After thirty-two treatments in five months she recovered, and has remained well to date, which is approximately a year and one-half.

CASE VI.—A man, aged thirty years, was referred by Dr. W. W. Babcock, November 13, 1906. He had a recurrence following the second operation for sarcoma of the region of the right shoulder blade. This recurrence was as large as his head. Two months of daily Röntgen treatment caused a degeneration of the tumor, which was then cleaned away with the fingers. The degenerated material weighed eleven pounds. After this he gained twenty pounds in weight. A portion of the tumor in the anterior axilla which had not been treated actively grew rapidly seven months after beginning treatment and caused his death.

CASE VII.—Mrs. M. M., aged sixty years, was referred by Dr. W. L. Rodman, April 26, 1904. She had been operated upon four times for round-cell sarcoma growing from beneath the right ear. The fourth recurrence was treated by the Röntgen-rays during the first six months of 1904. She is still well four years later.

CASE VIII.—Miss L. B., aged eighteen years, was referred by Dr. M. P. Warmuth, March 5, 1906. Following a bruise, a small round-cell sarcoma developed, involving the upper four inches of the fibula. After forty-seven treatments in three months she was symptomatically well, and has remained well over two years.

CASE IX.—Mr. F. B., aged fifteen years, was referred by Dr. W. L. Rodman, October 29, 1902, and was treated for recurrent osteosarcoma involving the right upper maxilla. He was given

sixty treatments in eight months, and has remained well five years and three months.

CASE X.—Mr. M. L. M., aged forty-six years, was referred by Dr. E. Laplace, August 17, 1905. His right leg and the finger of one hand had been previously amputated for osteosarcoma. A recurrence was present in the hand. After six months' treatment with the rays there was little change in the size of the tumor, and he asked for an amputation of the hand. He has remained well two years and one-half. Since then I have learned that little reduction takes place in the size of an osteosarcoma, but the recovery is shown by the increased deposit of lime salts, giving it the appearance of true bone.

CASE XI.—Dr. X., aged thirty-two years, was referred by Dr. W. W. Babcock, November 11, 1905. He was treated for recurrent sarcoma following removal of the right testicle, and for a metastatic growth in the *left* inguinal region twice the size of a hen's egg. He has recovered and has been well a year and three months. (Pathological study by Dr. Babcock.)

CASE XII.—A small boy, aged four months, was referred by Dr. L. W. Fox, March 19, 1907. A mixed-cell sarcoma had developed at two months of age in the right lower eyelid. It had been removed at the end of six weeks by Dr. Fox. Two weeks after the operation there were signs of a recurrence. This recurrence disappeared after four months and forty-two treatments, and he has remained well over a year.

CASE XIII.—Miss L. G., aged eight years, was referred by Dr. W. W. Babcock, May 7, 1907. Six weeks after a blow upon the jaw she developed a round-cell sarcoma of the upper jaw. The bone was curetted, and one week later x-ray treatment was begun. She was given thirty-five treatments between May 7 and July 19, 1907, when she appeared to be well. She remained well five months, when a recurrence followed the extraction of a tooth. This recurrence has again disappeared under treatment. (Microscopic study by Dr. Babcock.)

CASE XIV.—Mrs. S. H. C., aged sixty-nine years, was referred for treatment by Dr. W. W. Babcock, March 26, 1907. She had been operated upon twice. She was treated for recurrent and metastatic melanotic sarcomas upon the leg. After thirty-three treatments, in four months, the signs of the disease had disappeared. She remained well about a year, when there was a slight recurrence. This has again disappeared under treatment. (Microscopic study by Dr. Babcock.)

CASE XV.—Miss S. G., aged fifty-six years, was referred by Dr. Mary Griscom, February 2, 1906. A melanotic sarcoma had been excised from each scapular region three weeks previously. There were signs of recurrence in the wound at the beginning of Röntgen treatment. She received sixteen treatments in two months, when she was well. She has remained well two and one-half years.

CASE XVI.—Dr. H., aged fifty-four years, was referred by Dr. W. W. Babcock, May 17, 1907. Dr. Steel had removed a large melanotic sarcoma from the submaxillary region eight days previously. He was given postoperative treatment thirteen times until May 31, 1907. He is still well one year and four months since treatment. (Microscopic study by Dr. Babcock.)

CASE XVII.—Miss E. P., aged twenty years, was referred by Dr. E. Laplace, October 11, 1904. She had a sarcoma of the right shoulder, of three years duration, which was twice the size of the shoulder. It had been incised by the family physician for an abscess. Forty-seven treatments were given in ten weeks, with some retardation of the growth. Coley's toxins were then used, but without avail, and she died in a short time. No microscopic examination was made in this case.

CASE XVIII.—Mrs. L. W., aged forty-four years, was referred by Dr. L. W. Fox, May 18, 1906. She had a sarcoma of the left iris, which was reduced to one-half its original size by seventy-seven treatments. There has been no increase in the twenty-two months since treatment.

CASE XIX.—Mr. J. P., aged sixty-two years, was referred by Dr. L. W. Fox, December 13, 1905, on account of recurrent sarcoma of the orbit and metastases at the angle of the jaw. After twelve treatments in two weeks he left the city. The significant fact is that he returned a year later for an operation, but with no increase in the size of the tumors. He died a short time after the operation from a hemorrhage at the site of the wound.

CASE XX.—Mr. W. B., aged sixty-eight years, was referred by Dr. L. W. Fox. He was treated for recurrent sarcoma of the orbit. The pain was relieved after a few treatments. There was some improvement after forty-eight treatments, but the patient became discouraged and left the city.

CASE XXI.—Mr. J. P., aged thirty-seven years, was referred by Dr. Harry C. Deaver. He had a large recurrent sarcoma involving the right supraclavicular region and the side of the neck. He was treated without success.

CASE XXII.—Mr. R. T., aged seventeen years, was referred by Dr. E. Laplace, March 7, 1904, for treatment of a large angiosarcoma of the right cheek. The disease has been held in check four years.

CASE XXIII.—Mr. W. E. L., aged thirty-six years, was referred by Dr. Weis Hammer, November 18, 1907. He had a recurrence in the wound following the removal of the left testicle, which had become sarcomatous. He also had a metastasis in the left groin the size of a hen's egg. The recurrence and the metastasis disappeared completely in four months after forty-four treatments. He is still well six months since the last treatment.

CASE XXIV.—Miss M. F., aged fifty years, was referred by Dr. John B. Deaver, November 21, 1907. She had a recurrent sarcoma

in the left mammary region and signs of metastasis in the spine. The tumor on the chest had nearly disappeared under treatment, but the spinal metastasis showed no improvement, and later caused her death.

CASE XXV.—Mrs. M. M., aged sixty-one years, was referred by Dr. J. A. Peoples. She had a sarcoma of the right axillary region the size of her two fists, with some signs of mediastinal involvement. The tumor had disappeared, but a sluggish ulcer remained, which was about one inch in diameter. Microscopically this was a large and a small round-cell sarcoma. Coley's toxins were used in conjunction with the Röntgen treatment to improve this ulcer, and with apparent benefit at first, but later showed no benefit and only seemed to cause prostration. She is living a year after the beginning of treatment and is in better condition than at the beginning of the treatment, and I still have hopes of a recovery.

CASE XXVI.—A man, aged forty-five years, with a recurrent chondrosarcoma of the sternum, was referred by Dr. E. Laplace, February 14, 1908. The growth has been reduced to the level of the skin, but is not well, and he is still under treatment.

CASE XXVII.—A woman, aged thirty-six years, was referred by Dr. W. L. Rodman, January 15, 1908. Eleven weeks previously she had an endothelioma removed from the left breast. It was considered exceptionally malignant, and an extensive operation was done. Severe pains in the entire left side of the chest and some swelling in the axilla were present at the beginning of the treatment. Twenty-one treatments were given in three months, with entire relief of pain, no sign of recurrence, and with every sign of health and comfort to date.

CASE XXVIII.—Mrs. A. B., aged sixty years, with a recurrent spindle-cell sarcoma growing from the muscles of the left thigh, was referred by Dr. R. S. Dorsett, October 7, 1907. Under treatment the tumor degenerated and was curetted, but recurrence developed in the wound and she died in nine months from the beginning of treatment.

CASE XXIX.—A boy, aged nine years, was referred by Dr. E. Laplace, June 21, 1906, for postoperative treatment immediately after a resection of the right upper jaw on account of sarcoma. He was given nineteen treatments and has remained well over two years.

For further details of the above cases, the previous reports may be consulted. The following recent cases may be added:

CASE XXX.—Mr. G. N., aged twelve years, was referred by Dr. Warren C. Batroff, March 19, 1908. A small tumor had been growing from beneath the left ear during the past year and a half. At the beginning of treatment it was hard, adherent, slightly painful, and an inch and one-half in diameter. He had been given twenty treatments between March 19 and June 30, 1908, when the tumor

was reduced to one-half its original size and treatment was discontinued. No microscopic examination was made in this case. These fibrous tumors do not disappear entirely, but are reduced in size, and then remain stationary.

CASE XXXI.—Mr. G. R., aged forty-four years, was referred by Dr. E. Laplace, January 14, 1908. Twelve years ago a small tumor developed in the left parotid region, which was removed after three years. It recurred in seven years, and was again removed. It recurred in a year and was again removed. Immediately after the last operation, January 10, 1908, he was treated with the Röntgen rays. This tumor was found to be an endothelioma of the parotid. He was treated eighteen times in about a month, and has remained well since.

CASE XXXII.—Mr. W. U., aged twenty-seven years, was referred by Dr. Ernest Laplace, October 10, 1906. He had been operated upon August 8 and September 6, 1906, for sarcoma of the testicles, with removal of the inguinal glands on account of metastasis. He was given postoperative treatment. He has not answered a recent letter, but it is believed that if he had a recurrence he would have reported.

CASE XXXIII.—Mrs. J. W., aged fifty-nine years, was referred by Dr. J. W. Kennedy, June 12, 1908. Following slight traumatism, she developed a tumor in the right groin, which surrounded the vessels in Scarpa's triangle. A careful dissection was made and the tumor resected as well as possible in April, 1908. There was an immediate recurrence before the wound healed. Röntgen treatment was begun June 12, 1908. Sixteen treatments were given in a month. At the end of this time a superficial dermatitis had developed, but the induration had almost disappeared, and the outlook seems favorable.

CASE XXXIV.—Miss E. M., aged seventeen years, was referred by Dr. W. C. Hollopeter for a tumor involving the gastrocnemius muscle and the outer portion of the popliteal space. It was eight and one-half inches long and irregular in outline. Clinically it appeared to be a sarcoma, but a section removed by Dr. W. L. Rodman and examined by Dr. Henry S. Wieder showed it to be a fibroma. Treatment was begun July 3, 1908. Pain and discomfort have been practically relieved. The tumor is distinctly smaller and softer. She is still under active treatment.

CASE XXXV.—Mrs. M., aged forty-five years, was referred by Dr. John B. Deaver. She injured the left side of her face November, 1906. Nine months later a tumor developed at the site of the injury. The tumor was excised twice within three months, and at the second operation a metastasis was excised from the right side of the jaw. A recurrence developed, and Dr. Deaver excised the left upper jaw January 16, 1908. A recurrence developed at the side of the nose, and was excised by Dr. Deaver. Ten days after this last operation

there was a recurrence present about one inch in diameter. Later a recurrence developed at the site of the operation on the right side of the jaw. Sixty treatments were given in three months. There has been undoubted improvement, but the disease is still present.

Summary of Results in Sarcoma. Of the 35 cases reported, 9 are still under treatment, and have shown distinct improvement. Of the 26 cases in which the treatment has been discontinued, 8 have died and 17 have recovered, or at least were relieved of all symptoms. In other words, of these 26 cases in which treatment has been discontinued, 65 per cent. have recovered. Of the 17 cases that have recovered, 2 have had a recurrence. Case I had a recurrence in four months which followed a slight operation on the nose, from which she died. Case XIII had a recurrence following the extraction of a tooth, from which she has nearly recovered under treatment. Judging from these results, one might expect recoveries in at least 50 per cent. of the cases. When it is considered that practically all of these cases were of the hopeless variety from operative procedure, the results are truly remarkable.

Postoperative Treatment. The above results must not be interpreted as an argument against operation in operable cases. On the contrary, I believe that the best results will follow operation, if immediately succeeded by a thorough course of Röntgen-ray treatment.

Types of Sarcoma. It seems that the best results are obtained in the treatment of round-cell sarcoma, then mixed-cell, and then spindle-cell sarcoma. The three cases of melanotic sarcoma that were treated have recovered.

CARCINOMA. The results obtained in the treatment of carcinoma are much less encouraging. It is difficult to classify and summarize these cases, because I treated all cases that were referred to me, and some were really in a dying condition. In all, I have treated 304 cases of deep-seated carcinoma. I shall base my report upon my general observations and impressions rather than on a detailed statistical study.

Carcinoma of the Breast. I have treated only a few cases of primary carcinoma of the breast, and these were inoperable either because of the extent of the disease or because of the age and general condition of the patient. The results, as a whole, I believe, have been as good as those obtained by other methods in the same class of cases; but I always recommend operation in every operable case, to be immediately followed by a thorough course of Röntgen treatment. Dr. Russell H. Boggs, of Pittsburg, believes that a course of anti-operative treatment is more important than postoperative treatment, and I believe he is right.

Recurrent Carcinoma of the Mammary Region. If the recurrence is localized, is not associated with metastasis, and is treated early, the most brilliant results will follow. If, on the other hand, it is

extensive and metastasis has taken place, which is true in the majority of cases referred for treatment, we can, as a rule, only hope for palliation and prolongation of life. In nearly all cases there is some reduction in the size of the tumors and relief of pain, so that the patient is made comfortable.

Even though the treatment in this class of cases is only palliative, it is the only treatment that offers this much. At times, even in very advanced cases, when the supraclavicular and mediastinal glands are involved, good results may be obtained. An example of such a case is:

Mrs. R. C., aged sixty-one years, was referred to me by Dr. E. Laplace, October 29, 1903. She had been operated upon two years previously for carcinoma of the left breast. When she was referred to me for treatment, there were two nodules in the scar, respectively one inch and one-half inch in diameter. There were also enlarged supraclavicular glands palpable. She recovered from all these symptoms in three months and after forty-four treatments. Contrary to advice, she left the city for three months. When she returned she had a palsy of the left arm, evidently due to pressure of enlarged supraclavicular glands. There were also signs of enlarged glands in the mediastinum. She recovered in three months, and again left the city for the summer. When she returned in the fall she was again paralyzed in the left arm, and had some atrophy of the thenar and hypothenar eminences of the left hand. Under treatment she nearly recovered the use of the left arm and the hand, but this atrophy has been progressive since, which I believe is now due to secondary degeneration of the nerve. At present she is very weak in the left arm, but I can recognize no evidence of carcinoma.

Even though the results in this case are not all that could be wished for, they are nevertheless remarkable. She is living five years after there was involvement of the supraclavicular and mediastinal glands. During this time she has enjoyed the ordinary pleasures of life.

Carcinoma of the Neck. All of this class of cases were in the terminal stage, and were secondary to and followed operations for malignant disease about the arm or jaw. A number have improved and were made more comfortable for a time, but none of this class has recovered.

Carcinoma of the Jaw. All of this class were likewise recurrent and advanced. None has recovered, but some were free from symptoms for a time and had their lives prolonged a year or more.

Recurrent Carcinoma about the Face. These most commonly follow operations or caustic applications for epithelioma. They most commonly involve the orbit or the nose. If these recurrences are treated early, they will usually disappear. If treated after they have extended into the nasal cavity or one of the sinuses, they seldom recover, though they often show great improvement.

Carcinoma of the Esophagus. The results in this class have surprised me in a number of cases, in which the swallowing of liquids was difficult and of solids impossible at the beginning of treatment. Under treatment they have been able to swallow solid food, have increased in weight, and improved in general health. So far no case has recovered, but four cases under treatment at present are improving.

Carcinoma of the Stomach. I have treated ten cases of this class. All were very advanced and presented hemorrhages and palpable tumors at the beginning of treatment. All were weak and cachectic. Some showed improvement and one seemed to have recovered.

In October, 1904, I was called to a hospital in a neighboring city to see a white man, aged sixty-four years, upon whom an exploratory operation had been performed three weeks previously for carcinoma of the stomach. Dr. Joseph Price, who operated, found the lesser curvature involved by a large carcinoma. He made no attempt to remove it, and did not open the stomach. The man had complained of symptoms referable to his stomach for a year previously. He had two severe hemorrhages.

At the beginning of treatment by means of the Röntgen-rays he was bedfast, and very cachectic and emaciated. His red blood corpuscles numbered 3,200,000, and hemoglobin 55 per cent. After six weeks of daily treatment he was able to walk, had gained in weight, and gained 1,000,000 in red blood corpuscles and 20 per cent. in hemoglobin. He came to the city three times a week for treatment, and at the end of six months was attending to some business. He then developed symptoms of appendicitis. Dr. Price again did an exploratory operation. He found no appendicitis and no carcinoma. He found adhesions at the site of the original operation, which he liberated. The patient died in about three weeks, and no autopsy was permitted. This case had at least the outward appearances of success.

Carcinoma of the Rectum. The hopelessness of these cases is recognized by all surgeons. I have seen the best results follow operation and postoperative Röntgen treatment. I am sure I have seen life prolonged a year or more and the patient rendered more comfortable as a result of the treatment.

Carcinoma of the Uterus. Fourteen cases of this disease were treated in its most advanced and distinctly inoperable stage. Two seemed to have recovered, but have drifted out of my reach. One patient, in whom the entire pelvis had been infiltrated with the disease at the beginning of the treatment, seemed to recover, and left the hospital. She was a colored woman, and returned to the hospital a year later for an operation for keloid following an x-ray burn upon the abdomen. At this time she seemed to be free from malignant disease. Pain and discharge are often relieved for a time, but we can seldom hope for recovery.

Postoperative Treatment. Probably the greatest field of usefulness of the Röntgen-rays is in the postoperative, and probably anti-operative, treatment, wherever the malignant disease may be located. Boggs recommends this most strongly.

Statistics are not yet available to prove the value of this treatment, but those who have watched the results closely and fairly are favorably impressed with its value. We have all seen recurrences disappear and the patient remain well. It is likely, therefore, that if these carcinoma cells are exposed before they become palpable tumors they should be more easily destroyed. The fact that many surgeons feel positive of its value is a strong argument. An example of such expression is the following: Dr. Griscom says: "I consider it a most important postoperative treatment. The only case of breast amputation that I have lost in the past four years was one who lived too far away to get the treatment. Some of the cases treated were very far advanced."

These treatments should be given as soon as the patient can be safely moved to the laboratory for treatment. That is, usually within a week after the operation. They should be treated actively, and approximately fifteen or twenty treatments should be given. The glandular area should especially be treated.

TECHNIQUE. The technique of Röntgen therapy in general is difficult to describe, and this is especially true of the technique in the treatment of deep-seated malignant disease, because no two cases are alike, either in the distribution of the disease, in the degree of malignancy, or in the vitality of the patient. It is, however, best described under the following headings:

1. *Time of Exposure.* This will vary with the extent of the disease and with the degree of malignancy. Generally it should be from ten to thirty minutes, and when the exposure is over ten minutes it should be given in more than one direction, always, however, directing it toward the centre of the malignant tissue.

2. *Distance from the Anode.* This will vary with the depth of the disease. The deeper the lesion, the greater the distance of the anode from the skin and the longer the exposure. Generally the distance should be from ten to fifteen inches.

3. *Quality of Light.* Measured by the Benoist scale, it should be between 6 and 7, and this quality of light will be best obtained from an old tube.

4. *Milliamperage Going Through the Tube.* Unless one uses a water-cooled tube, it is difficult to keep a uniform vacuum with more than one milliampere going through it; and one milliampere is what I use.

5. *Frequency.* In a rapidly growing sarcoma, I believe that at first the treatment should be given daily, and after a month or two less often. I believe that carcinoma needs to be treated less frequently; three times a week I consider sufficient.

6. *Duration of the Treatment.* This will vary from a few months to several years. It should be continued, or, at least, the patient should be kept under observation, as long as disease is present, and should be watched closely afterward. The treatments may be given in series, allowing varying intervals depending upon the condition of the patient.

CONCLUSIONS. 1. Cases that are operable should be operated upon, and this should be followed by early and thorough postoperative Röntgen-ray treatment.

2. Sarcomas yield better to the x -rays than carcinomas. In sarcoma it seems from the foregoing results that we may hope for 50 per cent. of recoveries. In the series reported, 65 per cent. have recovered.

3. Localized recurrent carcinoma will usually yield to the Röntgen rays, unless the mucous membrane be involved.

4. Occasionally good results are obtained even in advanced cases of carcinoma, but generally one can hope only for palliation or prolongation of life.

5. Good results will depend very much upon good technique.

I am indebted to the physicians who have referred the patients for treatment, and to Dr. Henry S. Wieder, surgical pathologist to the Medico-Chirurgical Hospital, who made the pathological examinations.

IS PERCUSSION AS A METHOD OF TESTING THE LUNGS DESERVING OF GREATER ATTENTION?¹

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THE thoughtful observer can hardly fail to have noticed that the two methods commonly employed for testing the lungs, percussion and auscultation, as they are now taught and practised, differ fundamentally from each other in one respect: in auscultation the usual procedure is to apply the stethoscope to a certain spot on the thorax and then directly to observe the character of the respiratory sound, the inspiration, the expiration, rales, etc. In percussion, on the other hand, it is not the character of the percussion sound which is regarded as of primary importance, but with an earnestness and enthusiasm, worthy of more weighty objects, the importance of percussing symmetrically and comparing the percussion sounds at symmetrically situated spots is taught and practised. It is true that

¹ Read at the International Congress on Tuberculosis, Washington, D. C., September-October, 1908.

phenomena of auscultation are also studied by the symmetrical-comparative method, but this is merely a subsidiary procedure, which ensues after the character of the respiratory sound has been determined, and thus not until a necessary foundation has been laid, without which the comparison would be quite valueless. The symmetrical-comparative method at presents enjoys far too great a vogue to the prejudice of percussion as such and its development in the future. As a rule, the investigation does not proceed farther than to the examination of the difference in the percussion sound at two particular spots which are compared, and consequently sticks at that point, not advancing to the really essential point of the percussion, that is, the determination of the special character of the percussion sound itself, that is, to a judgment analogous to that pronounced in the case of auscultation.

The symmetrical-comparative method is obviously inadequate for establishing how far dulness is present or for determining the degree of dulness, as long as the character of the percussion sound (non-tympanitic, tympanitic, more or less dull, etc.), with which the sound under examination is being compared, has not previously been ascertained. The method of auscultation has, as I have already pointed out, a decided advantage at this stage. Having this firm ground to build on, auscultation precludes the occurrence of such errors as declaring that no alteration of the respiratory sound is present, simply because the symmetrical-comparative auscultation has not shown any difference in the respiratory sound at the points which are being compared, whether the sound is vesicular, bronchial, amphoric, or whatever it may be. In percussion, on the other hand, analogous errors as regards, for example, the existence of dulness, are quite conceivable, and as a matter of fact, as I have shown,² are of frequent occurrence. And these shortcomings can never be got rid of until the essential element in percussion, that is, the determination of the character of the percussion sound, is put in the first place, and the symmetrical-comparative method now in vogue is relegated to a secondary position.

The defects of the symmetrical-comparative method are in the main as follows: (1) If there is dulness in the percussion sound at two symmetrical spots, and the difference in the degree of dulness is indistinct, as is not infrequently the case, the dulness may remain unnoticed at both spots. (2) If there is dulness in the percussion sound at two symmetrical spots, and the difference in the degree of dulness is distinct, which often occurs, the dulness at the spot where the degree of dulness is greater may be miscalculated, that is, underestimated, and the dulness at the other spot may be neglected altogether.

It is a vital matter for present-day diagnostics not merely to be

² En studie i perkussion af lungorna, *Hygiea*, 1904, p. 125.

able to decide the question, "tuberculosis or not?" or, so to speak, to make a qualitative diagnosis, but also to determine at what stage the disease is, that is, to make a quantitative diagnosis. For this latter purpose it is necessary to determine the degree of dulness as well as the existence of dulness itself, to decide, for instance, whether a high or a low degree of dulness³ is present.

To those who have not thought over the matter carefully or have not had an opportunity of testing and comparing the pronouncements of various investigators on the dulness and degree of dulness, it might seem that the task is comparatively simple. One author⁴ even ventures to assert, that if the dulness be more distinct, for example, D^3 , D^4 , and D^5 (see below), it would be impossible for two observers to hold different opinions. My investigations have shown that just the reverse is the case; that in the question as to dulness great confusion prevails, that different observers, on the contrary, often arrive at widely different results even, and, indeed, as I shall explain later, especially with regard to the high degrees of dulness.

It is impossible for us to escape from this regrettable fact, which must be patent to all who will take the trouble to study the evidence. The explanation lies ready to hand: (1) As I have shown in the symmetrical-comparative percussion method, an existing dulness is often ignored or underestimated; (2) the judgment is dependent on the investigator's more or less trained, more or less keen, susceptibility to sound; and (3) there exist no recognized definitions for degrees of dulness in lung percussion. Under the present conditions this aspect of percussion lies to such an extent at the mercy of subjectivity that, practically speaking, it has hardly any value at all. No wonder then that we are continually hearing auscultation praised at the expense of percussion, and that some even go so far as to assert that the former method may be used to check the latter.⁵ It is owing to the misuse of the symmetrical-comparative method that percussion, as a whole, has fallen into discredit. Percussion still remains a quite independent method of investigation, which permits as little of checking by means of auscultation as vice versa. But this would lead me into the question whether both these methods and others besides are not required for a determination of the state of the lungs, a question which I need not enter into here.

Another defect of the symmetrical-comparative method, which is a corollary of those above mentioned, has been even less observed than they: that is, that the degree of dulness in general, and more especially when it is considerable, is regularly underestimated, and to such extent is this so that it is actually a very rare occurrence

³ Turban-Gerhardt'sche Stadieneintheilung d. Tuberculosis, Kaiserl. Gesundheitsamt, 1907, p. 560.

⁴ O. V. Petersson, Om tuberkulinprofoet och tidigdiagnosen af lungtuberkulos, Upsala, läkarefören. förhandl., Band ix, Heft 5 and 6.

⁵ Israel Rosenthal, Hvorledes bör man perkutere Lungerne? Bibl. for Læger, 1904, p. 479.

to find a high degree of dulness registered, for example, in medical reports.

A little reflection will easily guide one to the explanation, if we bear in mind: (1) That the attention in the symmetrical-comparative method of percussion is directed to the difference in the dulness of the percussion sound at the two points which are being compared; (2) that in cases of tuberculosis of the lungs dulness regularly occurs on both sides of the lungs;⁶ and (3) that the difference in the degree of dulness at symmetrical points is comparatively slight. Assume, for instance, that on the right side we find the degree of dulness D^3 and on the left D^2 . The difference between D^3 and D^2 is D^1 , from which we judge that a low degree of dulness is found on the right side. Or, again, we find D^5 on the right side and D^2 on the left. From the difference D^3 we pronounce it to be a medium degree of dulness on the right, etc. This means that the degree of dulness is underestimated and that the high degree of dulness does not have a chance of coming under observation.

This defect comes to light when we examine the casuistries, even of such a famous investigator as 'Turban.'⁷ This author, who, like so many others, recommends—with some reserve—the symmetrical-comparative method, has in the definition of a severe lung affection⁸ included among other determinations a high degree of dulness. Now, when we peruse the 106 cases in Turban's third stage, among which many severe cases of lung affection are to be found, we might naturally expect to find a high degree of dulness frequently registered. This is, however, not the case. As a rule, about 250 times, only "dulness" has been registered, without assigning the degree of dulness; about 50 times we find "slight dulness" or other expressions indicating a low degree of dulness, and only five times do we find a high degree of dulness registered.

When in cases of tuberculosis of the lungs we hear of different degrees of dulness, a low, a medium, and a high degree of dulness, short tone, etc., there seems, as a rule, to be no exact notion of what it is that is dull, whether it is the whole complex of sounds, the percussion sound as a whole, or only a part of it, and in that case which. In most cases an analysis of the sound complex is not resorted to, but it is considered sufficient to pronounce judgment on the sound, as a whole, as more or less dull. Thus, it seems to be a common procedure to compare the degrees of dulness at symmetrical spots of, for example, a non-tympanitic sound on one side and a tympanitic sound on the other. It can readily be understood that in this or similar procedures

⁶ C. E. Waller, loc. cit. As we know, Turban has previously proved that the respiratory sound also in the case of tuberculosis of the lungs is, as a rule, abnormally formed on both sides, at least at the apices. This fact, as well as the points to which I have drawn attention regarding the dulness, bear out the view that tuberculosis of the lungs is a double-sided disease even at an early stage, though, as a rule, it attacks one lung somewhat more than the other.

⁷ Beiträge z. Kenntniss d. Lungentuberkulose, Wiesbaden, 1899.

⁸ Loc. cit., p. 31.

most unreliable results may be yielded by the percussion, and the investigators may be startled when they proceed to auscultation by the occurrence of contradictory phenomena, such as rales, highly audible, prolonged expiration, etc., in places where no dulness whatever or only slight dulness was previously found.

In order to get a suitable basis from which to investigate the degree of dulness it is necessary, before the symmetrical-comparative percussion is undertaken, first to observe and study the character of the percussion sound, to see whether it is non-tympanitic, tympanitic, dull, or clear, etc. Among the percussion sounds which are to be heard from the lungs, three principal kinds may be distinguished: (1) The non-tympanitic sound; (2) the tympanitic sound which is to be heard, for example, over relaxed lungs, the *relâchement* tympanitic sound; (3) the tympanitic sound heard over a cavity, which is of the same nature, though not of the same pitch, as the percussion sound from the trachea, or what we may call the tracheal tympanitic sound.

The percussion sound from normal lung tissue includes in a great measure the so-called non-tympanitic sound, characteristic of normal lung tissue, which has long been known. Now, can this sound, the normal lung sound, serve as a basis for determining the degree of dulness?

If we follow the vicissitudes of the non-tympanitic sound in different stages of the development of lung tuberculosis, from the incipient stage to cavity formation, we find the following results: The clear non-tympanitic sound which is heard under normal conditions upon a slight tap (*e. g.*, in the lateral part of the fossa infraclavicularis), becomes first somewhat or distinctly short and is at the same time commingled more and more with the tympanitic sound, characteristic of relaxed lung tissue. This latter sound can thus be heard at a certain stage of development from a part (the beginning) of the inspiration and (the end) of the expiration, while the non-tympanitic sound is still heard from another part (the end) of inspiration and (the beginning) of the expiration. When the development has proceeded further, the non-tympanitic sound is no longer heard in ordinary respiration at any part of the phases of respiration, but in forced respiration it is still heard at the end of the inspiration and the beginning of the expiration.⁹ All these variations belong to the incipient stage of tuberculosis of the lungs and form together what we should place under the heading of "slight dulness." As the process goes on, the non-tympanitic sound is inaudible upon a slight tap, even if the respiration is forced. It has as it were fallen out of the game beyond the range of slight percussion, but during the next stage of development it can be produced by augmenting the strength of the percussion. For in

⁹ This seems to answer to what Aufrecht terms "Umkehr des Perkussionsschalles." See p. 137 in his book *Pathologie und Therapie d. Lungenschwindsucht*, Vienna, 1905.

proportion as the process goes on with increasing infiltration, it will be necessary to increase the strength of the percussion to produce the non-tympanic sound, until at last it is no longer heard even following a sharp (not, of course, a violent) tap. This latter symptom corresponds to the stage of the permanent infiltration with or without incipient softening. In the final, the cavity stage, the non-tympanic sound is still inaudible even upon a sharp tap. In this stage the tracheal tympanic sound, with its well-known sound-variation phenomena, enters on the scene.

On the basis of these sound variations, that is, the behavior of the non-tympanic sound upon percussion of different degrees of strength, I have founded a new method of percussion for determining the degree of dulness. It is distinguished from the old method mainly by the fact that the degree of dulness in cases of lung tuberculosis is not judged according to the degree of dulness in the percussion sound as a whole, but only in a certain part of it, that is, the non-tympanic sound.

In 1903 I pointed out for the first time—in the Swedish Medical Society at Stockholm—the shortcomings of the symmetrical-comparative method and described my own method of percussion. In the following year this was published in the periodical of the society, *Hygiea*. I shall now give, with the utmost brevity and conciseness, a sketch of that method, with the additions and modifications which have proved to be necessary in the course of its development.

This is how it runs in summarized form:

1. *Weak Percussion*: (a) The non-tympanic sound is heard throughout the respiration, though somewhat or distinctly short: First degree of dulness (sign: D^1).¹⁰ (b) The non-tympanic sound is heard only during a part of the respiration, when the breathing is ordinary or forced: Second degree of dulness (sign: D^2). (c) The non-tympanic sound is quite inaudible. The strength of percussion is increased to

2. *Medium Percussion*:¹¹ (a) The non-tympanic sound is heard: Third degree of dulness (sign: D^3). (b) The non-tympanic sound is not heard. The strength of percussion is increased to

3. *Strong Percussion*: (a) The non-tympanic sound is heard: Fourth degree of dulness (sign: D^4). (b) The non-tympanic sound is not heard: Fifth degree of dulness (sign: D^5).

By this new method, for some years employed by a number of Swedish doctors, it is not merely possible to determine the different

¹⁰ This simpler designation corresponds to those first proposed: slight, slight relative, almost relative, relative, and strong relative, which were discarded as unsuitable.

¹¹ As the expressions "medium" and "strong" percussion might possibly convey the impression that a really strong tap was intended, such as is still sometimes heard, for example, when percussion is being demonstrated to an audience, I should perhaps have used the terms "less weak" and "still less weak," etc., in order to emphasize the importance of weak percussion, but from linguistic considerations and presuming that no practitioner who really knows his business will misconceive me, I prefer to retain those I have used above.

degrees of dulness with greater accuracy, so that, for instance, a difference in the degree of dulness from one examination to another can be more exactly determined, and the different degrees of dulness, even the higher ones, be more correctly estimated: the method also enables the examiner to detect without any great difficulty an incipient dulness at an earlier stage than is now generally the case. Moreover, when this method is employed, different examiners are, relatively speaking, much more in agreement in their determination of the degree of dulness present than they were before. The results can, furthermore, be arrived at without recourse being had to the symmetrical-comparative method. The latter method of percussion consequently should be relegated to a subordinate place, just as the analogous symmetrical-comparative method of auscultation is employed in conjunction with, but subsidiary to, the method of auscultation.

Beyond the range of the five degrees of dulness enumerated above lies the degree of absolute dulness, that is, the percussion phenomenon we meet with in cases of pleuritic exudations, well known to the medical practitioner.

In view of the known difficulties presented by percussion in the supraclavicular and supraspinous fossæ, as pointed out by Tsak Jundell in a noteworthy monograph,¹² and by others, the following practical advice may be given to anyone intending to adopt the new percussion method. Begin the percussion of the back and the front not at the fossæ above mentioned, but at the places which, under normal conditions, yield a clear and full percussion sound, namely, in front of the infraclavicular fossa somewhat laterally to its centre, and on the back in the neighborhood of the angle of the scapula in the infrascapular space or in the trigonum stetosopicum.

Having as a preliminary carefully noted the character of the percussion sound—its degree of dulness in accordance with the new method—at the points just mentioned, we can then go on to percuss at the supraclavicular fossa, etc., first on one side and then on the other, at the front, on the side, and on the back.

Percussion of the back offers special points of interest. If on beginning, for instance, at the trigonum stetosopicum on the left side one finds the non-tympanitic sound, and then proceeds making the percussion from below upward, being careful to notice when this sound is no longer heard at a slight tap (is superseded, for instance, by the *relâchement* tympanitic sound), he will find, as a rule, on applying the same method of percussion on the other, the right side, that the limit of the audible non-tympanitic sound reaches higher up on the side where a lesser degree of dulness is heard in front in the infraclavicular fossa. Thus, for instance, if D^4 has been

¹² Bemerkungen zur Percussion der Lungenspitzen, Zentralblatt f. innere Medizin, 1904, No. 17.

found in the left infraclavicular fossa and D^5 in the right, the said limit will be found on the back to reach somewhat higher up on the left than on the right. This is such a regular occurrence (save only in the case of the crossed dulness described by Turban¹³) that this percussion phenomenon can serve to check the accuracy of the determination of the degrees of dulness in front in proportion to each other.

As in ordinary cases of tuberculosis of the lungs, the higher degree of dulness is to be sought in the upper part of the lungs, and the degree of dulness, as a rule, diminishes from above downward, it will in many cases be found quite sufficient for practical purposes, for example, for determining the stage which the disease has reached, for comparison of the state on other occasions of examination, etc., to register out of the whole result of the percussion only the following points: In front the degree of dulness in the infraclavicular fossæ on both sides (in the supraclavicular fossa the degree of dulness is often the same as or merely one degree higher than in the infraclavicular fossa; of course, if the difference is greater, it should be entered, for example infraclavicular fossa D^2 , supraclavicular D^4); and on the back the position of the said limit of the non-tympanitic sound (for example, at the line of the spinous processes of the different vertebræ).

It was noted above, as one of the defects of the ordinary symmetrical-comparative method of percussion, that a high degree of dulness is but rarely observed, and examples were given from Turban's casuistries. By way of comparison and as a proof that the new percussion method yields much more trustworthy results I may be allowed to point out that after the examination of the same number of diaries (106), (taken in numerical order and thus not selected) dealing with patients likewise in Turban's third stage (at the Halabult Sanatorium, 1907), a slight degree of dulness (D^1 and D^2) was found registered 35 times, a medium degree of dulness (D^3) 94 times, and a high degree of dulness (D^4 and D^5) 133 times. Analogous results, likewise decidedly in favor of the new method of percussion, have also been obtained by a similar comparison made as regards patients in Turban's first and second stages.

Opinions may differ as to the suitability of the number of degrees of dulness. Some consider three degrees sufficient, for example, weak, medium, and strong; others perhaps would content themselves with two, weak and strong. There are, however, grounds—apart from the facility which it would afford for finer shading—which speak for the suitability of a somewhat greater number. By subdividing the slight dulness into two degrees (D^1 and D^2), greater attention is bound to be drawn to slighter degrees of dulness, which consequently will not so readily escape observation. The medium

¹³ Loc. cit.

degree of dulness (D^3), which is of such frequent occurrence both in milder and in more severe cases of lung affection, should, of course, exist as a separate category. Finally, the two degrees of strong dulness (D^4 and D^5), cannot but be differentiated, and that for a special reason. It is in the fifth degree of dulness (D^5) that the phenomena of sound variation, noticed long ago by Wintrich and others, are almost exclusively (according to calculation in more than 90 cases out of 100) to be found. Wherever D^5 occurs those phenomena must be looked for. The fifth degree of dulness consequently constitutes in itself a reply to the hitherto unanswered question: In what cases may the sound variation phenomena be looked for? Indeed, with this clue to guide us, the phenomena are met with much oftener than formerly, when it was, as it were, quite by accident that one came across them. In Turban's casuistries, above referred to, of the 106 cases in the third stage, we find "Schallwechsel" mentioned 8 times. If we examine an equal number of cases (taken in numerical order) in the same stage from the Halahult Sanatorium, 1907, we find Wintrich's phenomenon entered 37 times (not counting 5 dubious cases). The difference would doubtless have been still greater if the Halahult cases had been as far advanced as the Davos cases, which, judging by other symptoms, seems nowise to have been the case.

There is another circumstance, however, which must have contributed in some measure to the detection of such a comparatively large number of cases of Wintrich's phenomenon, and that is the employment of a new technical detail in percussion. The indirect percussion of the lungs, as we know, should, as a rule, be made with a slight tap on the plessimeter firmly pressed against the chest wall. There is one exception to the rule as to a slight tap, that is, the mode of percussion mentioned above for determining the higher degrees of dulness (D^3 , D^4 , and D^5). There is likewise an exception to the rule as to the plessimeter being pressed firmly against the chest wall, that is, when percussing for the tracheal tympanitic sound. For that sound comes out more plainly, purer, and less obscured by or mixed with other sounds if the examiner does not press the plessimeter finger (the author employs finger-finger percussion almost exclusively) firmly against the underlying structures, but, holding it straight and firm by its flexor and extensor tendons allows the ball of the finger to pass with the utmost lightness over the skin, while with the hammer-finger (the top or ball of the finger) he percusses "staccato" on the back of the last phalanx of the plessimeter finger. With the aid of this technicality it will often be comparatively easy thoroughly to percuss the entire region (for example, the supraclavicular and infraclavicular fossæ), where the tracheal-tympanitic sound and its sound-variation phenomena occur. This sound and its variations in ordinary cases of tuberculosis of the lungs will at first be observed

on tapping the clavicle.¹⁴ Direct percussion on the clavicle with this object in view is performed not by percussing as usual with the top of the finger (Fig. 1) but with the ball of the finger (Fig. 2).

CONCLUSION. 1. By noticing the varying character of the non-tympanic sound upon different strengths of percussion, dulness can be detected and its degree established with greater certainty and quite independently of the symmetrical-comparative percussion method.



FIG. 1

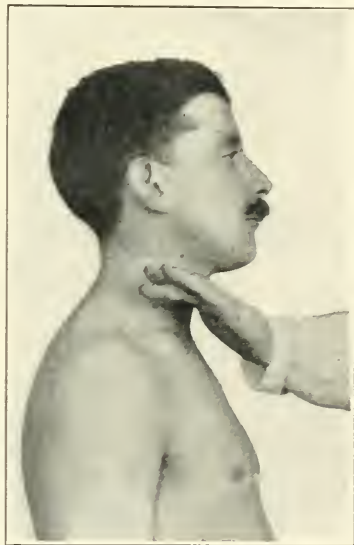


FIG. 2

FIG. 1.—Showing how the fingers should be held in ordinary direct percussion. Finger-top percussion.

FIG. 2.—Showing how the fingers should be held in direct percussion of the tracheal tympanic sound. Finger-ball percussion.

2. The symmetrical-comparative percussion method, as usually applied, is inadequate and misleading for the determination of the presence and the degree of dulness; it should, therefore, be dislodged from the prominent position it now occupies.

¹⁴ Naturally not to be confused with the similar percussion sound from the trachea.

SPECIFIC AIDS IN THE DIAGNOSIS AND PROGNOSIS OF TUBERCULOSIS.¹

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I PURPOSE to consider the relative value of specific aids in the diagnosis and prognosis of tuberculosis; first, of tuberculin in its various methods of application, and second, of the serum reactions and particularly the agglutinin reaction, in the light of my own investigations as compared with those of other observers.

With the introduction of tuberculin a most valuable aid was afforded in determining the presence or absence of tuberculous affections in doubtful cases, and increased interest in the subject was actively aroused by the almost simultaneous and independent communications of Wolff-Eisner² and Calmette³ of their conjunctival method, and of von Pirquet's⁴ cutaneous method of applying tuberculin for diagnostic purposes.

From the literature I have collected a large number of results of the use of the subcutaneous, cutaneous, and conjunctival methods respectively.⁵ From a tabulation of these results, it appears that by the subcutaneous method, among 7088 cases tested there were 4805 tuberculous, in 4319 of which the reaction was positive; 479 suspects, with 313 positive reactions; and 2804 non-tuberculous cases, in 1440 of which positive reactions occurred. By the conjunctival method, among 6449 cases tested, there were 2734 tuberculous, in 2164 of which reaction was positive; 1188 suspects, with 687 positive; and 2527 non-tuberculous subjects, with 347 positive reactions. By von Pirquet's cutaneous method, among 6504 cases tested there were 2182 tuberculous, with 1861 positive reactions; 815 suspects, with 550 positive reactions; and 3507 non-tuberculous subjects, in 1109 of whom the reaction was positive. The latter figures include results in 900 non-tuberculous children, of whom 149 had reacted positively. Excluding these cases, there are positive results in 1060 out of 2607 non-tuberculous adults.

The percentages of cases in which positive reactions followed the application of the tests were, respectively:

¹ Read by title at the International Congress on Tuberculosis, Washington, D. C., October 3, 1908.

² Berl. med. Ges., May 15, 1907. Discussion zu v. Pirquet's Vortrag., Berl. klin. Woch., 1907, xlv, 700.; Beitr. z. Klin. d. Tuberk., 1908, ix, 1.

³ Presse médicale, June 19 and July 13, 1907 (cf. Zentrbl. f. Chir., 1907, xxxiv, 1031).

⁴ Berl. med. Ges., May 8, 1907 (cf. Berl. klin. Woch., 1907, xlv, 644, 700); Wien. med. Presse, 1907, xlviii, 155; Kutane und konjunktivale Tuberkulinreaktion, in Krause and Levaditi, Immunitätsforschung, Jena, 1908, I, 1035 (1042); Wien. klin. Woch., 1907, xx, 1123; 1908, xxi, 623.

⁵ Owing to lack of space, it has been necessary to omit this and all other tabulations prepared for this paper. The literature has been considered up to July, 1908.

	Tuberculous. Per. cent.	Suspects. Per cent.	Non-tuberculous. Per cent.
Subcutaneous	89.85	63.34	51.30
Conjunctival	79.20	57.80	13.73
Cutaneous	85.29	67.48	31.62
Exclusive of children, 40.66			

At the Winyah Sanitarium tuberculin has been injected for diagnostic purposes since 1891 in 300 cases, with positive reactions in 75 per cent. at a period of the disease in which tubercle bacilli were absent from the sputum or in which there was no expectoration. The conjunctival method has been applied in 127 cases, 101 tuberculous and 26 non-tuberculous. Of the tuberculous, 23 were cured or arrested cases which had been treated specifically and discharged from one to ten years previously, and whose health had remained good. Thirty-four were, at the time, under treatment with specific remedies; the additional 44 cases were tested on admission to the institution, and had not been so treated.

For the tests, solution of the alcoholic precipitate of tuberculin prepared, according to Calmette's formula, from tuberculin from human tubercle bacilli, was used, and also an identical preparation from bovine bacilli.

Of the 23 cured and arrested tuberculous cases, none reacted to instillations of human purified tuberculin into the right eye. In 16 of these, bovine tuberculin was instilled into the left eye; 9 failed to react, in one there was a trace, in 4 the reaction was positive in the first degree, in one in the second degree, and in the other, in which there was a chronic conjunctivitis, a severe third-degree reaction accompanied by fever occurred. This latter case, however, failed to react to cutaneous application of human tuberculin. All these patients had been treated with specific products of human tubercle bacilli.

Of the 34 cases in which the test was made while under specific treatment, instillations of human purified tuberculin were made in the right eyes of 33. There was no reaction in 18, while in 15 the reaction was positive—slight in 9, of the first degree in 4, and of the second degree in 2. Of the 18 cases which failed to react to instillations of human purified tuberculin into the right eye; 14 received purified bovine tuberculin into the left eye, with positive results in 11, while 3 proved negative to both preparations. Of 12 cases which had reacted positively to human, 11 reacted also to bovine tuberculin in the other eye. Of the 44 tuberculous patients who had received no specific treatment, 28, or 63.64 per cent., reacted positively to first instillations of human tuberculin in the right eye. Two additional cases reacted to a second instillation of the same preparation in the same eye. The remaining 14 were negative. Of the same 44 cases, 30 received also instillations of bovine tuberculin in the left eye. Of these 30, the reaction was positive to both preparations in 14, negative to both in 7, positive to human but

negative to bovine tuberculin in 2, negative to human but positive to bovine tuberculin in 7, to the first instillations respectively. Deducting the 7 cases in which neither preparation caused reaction, there is a total of 37 (84.09 per cent.) in which the reaction was positive.

There remain for consideration the 26 non-tuberculous cases, all of which were in good health and free from suspicion of infection. None reacted to instillations of human tuberculin into the right eye; 10 received second and third instillations with solutions up to 4 per cent. in strength of this preparation into the same eye, with entirely negative results. Bovine tuberculin in 1 per cent. solution was also instilled into the left eye of 18, likewise with negative results.

Cohn,⁶ Fritz Levy,⁷ Klieneberger,⁸ Schenck and Seiffert,⁹ Rosenau and Anderson¹⁰ and others have found that clinically non-tuberculous persons react to second or third instillations of tuberculin into the same eye after previous instillations have been negative. It has therefore been objected that such repeated applications cause local hypersensitiveness of the conjunctiva, and thus render the reaction of no clinical value. Roepke,¹¹ however, denies that in persons free from tuberculosis repeated instillations into the same eye cause reaction, and, moreover, insists that only such repeated instillations of tuberculin, in solutions up to 4 per cent., are sufficient to cause reaction in all active tuberculoses. The negative results of repeated instillations reported by Smithies and Walker,¹² and my own experience in the ten cases already mentioned, incline me to Roepke's view, but the question requires further investigation.

It is of interest to note that the percentages of positive reactions to the first instillation of human tuberculin in my own tuberculous cases bear a very evident relation to the employment of specific medication:

	Per cent.
Of 44 untreated cases, the reaction was positive in	63.64
Of 34 cases under treatment, the reaction was positive in	44.1
Of 18 cases under treatment for six months or longer, the reaction was positive in	27.77
Of 23 cured or arrested cases which had received specific treatment, the reaction was positive in	None

Such an influence has been observed by others also. Mitulescu¹³ reports six cases treated specifically and apparently cured, in all of which reaction was negative, and like experiences are recorded by

⁶ Berl. klin. Woch., 1907, lxiv, 1507.

⁷ Deut. med. Woch., 1908, xxxiv, 94.

⁸ Ibid., 777; Münch. med. Woch., 1907, liv, 2588.

⁹ Münch. med. Woch., 1907, liv, 2269.

¹⁰ Jour. Amer. Med. Assoc., 1908, l, 961.

¹¹ Beitr. z. Klin. d. Tuberkulose, 1908, ix, 353.

¹² Jour. Amer. Med. Assoc., 1908, l, 259.

¹³ Wien. klin. Woch., 1908, xxi, 727; Deut. med. Woch., 1903, xxix, 367).

Schultz-Zehden,¹⁴ King,¹⁵ Citron,¹⁶ Lenhartz,¹⁷ Damask,¹⁸ and others. The fact that patients while under specific treatment, as will be shown later, acquire a progressive increase of their serum-agglutinating power, and that the specific amboceptor becomes likewise present in greater quantitative degree, would seem to indicate that, as specific resistance to the pathogenic action of the tubercle bacillus increases, patients react to tuberculin with less and less frequency, and finally not at all.

It may, therefore, be asserted, that the conjunctival tuberculin test may supply the final proof of a cure, just as subcutaneous injections of tuberculin have been administered for the same purpose. In a former publication jointly with Dr. Karl von Ruck¹⁹ I have called attention to the value of the tuberculin test in this respect, which Heron²⁰ considers as a corollary to the diagnostic value of tuberculin.

The test has also thus been employed by Bandelier,²¹ Holdheim,²² and by Mitulescu, who considers as actually cured only such cases as fail to react to tuberculin. Further prognostic inferences I have been unable to draw from my own studies thus far, and I have not observed any apparent relation between the degree of reaction to either the conjunctival or the cutaneous test and the severity or extent of the disease, which would lead to the modification of a prognosis based upon other considerations. Therefore, like Klieneberger, Schroeder and Kaufmann,²³ and especially Roepke, I cannot subscribe to the opinions expressed by Stadelmann and Wolff-Eisner,²⁴ Damask, Heinemann,²⁵ and Fritz Levy in this respect.

Cutaneous tuberculin tests have also been made at the Winyah Sanitarium in 107 cases, both human and bovine tuberculin having been employed in nearly all. Of 67 clinically tuberculous patients tested with human tuberculin in 50 per cent. solution, a positive reaction occurred in 44, in 4 the reaction was doubtful, and in 19 the result was negative. Of these 67 cases, 60 were also tested with bovine tuberculin in 50 per cent. solution; 24 gave a positive reaction, in 1 the reaction was doubtful, in 35 it was negative. Between the two tests in most cases about two weeks elapsed, the human tuberculin having been employed first. The above cases were in most instances receiving specific treatment when the tests were made.

Of 16 cured cases in which the tests were applied simultaneously (that is, human and bovine tuberculin), 12 reacted positively to a 50

¹⁴ *Therapeut. Monatsh.*, 1908, xxii, 177.

¹⁵ *Medical Record*, 1907, lxxii, 976.

¹⁶ *Berl. klin. Woch.*, 1907, xlv, 1052; *Deut. med. Woch.*, 1908, xxxiv, 316.

¹⁷ *Münch. med. Woch.*, 1907, liv, 2404.

¹⁸ *Wien. klin. Woch.*, 1908, xxi, 121.

¹⁹ *A Clinical Study of 261 Cases of Pulmonary Tuberculosis*, Asheville, N. C., 1905, p. 17; *Journal of Tuberculosis*, 1899, i, 179.

²⁰ *Transactions of the British Congress on Tuberculosis*, 1901, London, 1902, iii, 84.

²¹ *Deut. med. Woch.*, 1902, xxviii, 357.

²² *Berl. klin. Woch.*, 1904, xli, 1040.

²³ *Münch. med. Woch.*, 1908, lv, 62.

²⁴ *Deut. med. Woch.*, 1908, xxxiv, 227.

²⁵ *Münch. med. Woch.*, 1908, lv, 556.

per cent. solution of human tuberculin, 1 was doubtful, and 3 were negative. To the bovine tuberculin 9 gave a positive and 7 a negative reaction. Of 24 clinically non-tuberculous persons, mostly tested simultaneously with both preparations, 12 gave a positive result, in the case of human tuberculin, 1 gave a late reaction (three days), 11 were negative. To the bovine tuberculin 6 gave a positive reaction and 18 were negative.

In the entire material there were only 4 second degree reactions to human tuberculin, and 3 to bovine. In general the reactions were very mild. In one case classed as "cured," in which 1 per cent. bovine purified tuberculin was instilled into the left eye at the same time at which both cutaneous tests were made, the temperature rose to 100.2° F. the next day. The reactions persisted for several days, up to one week, pigmentation being visible for several weeks after vaccination.

My own experience, like that of many others, has been that the respective results are often contradictory and warrant no definite conclusions. It should be mentioned, however, that, with two exceptions, those tested were all adults, for whom v. Pirquet himself asserts the method to be unreliable. With Detre's²⁶ modification, which consists in substituting the filtrates of respectively human and bovine cultures for the concentrated tuberculin, and by the reaction to which he claims to differentiate the type of infection, I have had no experience. Neither have I tested any patients after Moro's²⁷ and Lignière's²⁸ methods.

The specific nature of both the conjunctival and the cutaneous tuberculin reactions has been denied by various writers, for reasons similar to those some years ago alleged in evidence that the reactions induced by subcutaneous injection of tuberculin should not be so considered.

For all three methods it has been objected that reactions occur in health and in other diseases, notably in typhoid fever. Of 70 cases of the latter affection which I have found in the literature, positive reactions followed conjunctival instillations of tuberculin in 20, or 28.57 per cent. I shall enter into the question of the reaction in typhoid fever patients more fully when considering the serum reactions. Suffice it to say that these apparent contradictions can neither militate against the specific nature of tuberculin reactions nor minimize their diagnostic value, since the percentage of positive results is quite generally in harmony with autopsy findings of tuberculosis in the clinically non-tuberculous, and not only in the adult, but it also corresponds very closely in children to the frequency of infection as shown postmortem with advancing age.

²⁶ Wien. klin. Woch., 1908, xxi, 173.

²⁷ Münch. med. Woch., 1908, lv, 216.

²⁸ Recueil d. méd. vétér., etc., 1907, lxxxiv, 514 (cf. Zentralbl. f. Bakt., Ref. 1908, xli, 81).

Thus Schreiber²⁹ reported, in 1891, subcutaneous injections of tuberculin, even up to 10 mg. as an initial dose, in 40 newborn children, with negative results in all. By Binswanger³⁰ 261 children under one year of age were injected, with positive reactions in 35, or 13 per cent. Forty-two of these children came to autopsy; 16 of them had reacted positively, and all these were found tuberculous. Of the 26 remaining children who had not reacted, 25 were found to be free from tuberculosis.

According to the conjunctival tuberculin test practised in 294 children, Ausset³¹ has also confirmed in general the findings as to frequency of tuberculosis in childhood. The percentage of positive reactions rises gradually after the first three months of life, as is shown in the following table:

13 children, 0 to 3 months	0, or 0.01 per cent.
53 " 0 to 1 year	8, or 15.09 "
31 " 1 to 2 years	7, or 22.5 "
23 " 2 to 3 "	8, or 34.7 "
33 " 3 to 4 "	12, or 36.3 "
22 " 4 to 5 "	9, or 40.9 "
17 " 5 to 6 "	10, or 58.8 "
21 " 6 to 7 "	9, or 42.8 "
19 " 7 to 8 "	13, or 68.4 "
10 " 8 to 9 "	6, or 60.0 "
65 " 9 to 15 "	38, or 58.4 "

For the cutaneous method, v. Pirquet reports reactions according to age in 988 children, as follows:

	Months.			Years.						Total
	0-3	3-6	6-12	1-2	2-4	4-6	6-10	10-14	14+	
All cases	147	64	67	86	127	101	182	100	112	988
Positive	—	3	11	21	47	54	106	68	100	407
Per cent.	—	5	16	24	37	53	57	68	90	41
Clinically non-tuberculous:										
Cases	147	50	59	65	92	58	111	64	37	693
Positive	—	—	2	1	11	11	39	35	26	125
Per cent.	—	—	3	2	13	17	35	55	70	18

N. B.—The actual totals are 986 cases instead of 988, with 410 (not 407) reactions. There are 683 (not 693) clinically non-tuberculous, with 125 positive reactions. S. v. R.

Like statistics, for both children and adults, presented by Petruschky³² include 460 cases of all ages, in which the age frequency of cutaneous reactions to tuberculin is given below:

²⁹ Klin. Jahrbuch. Ergänzungsband, Berlin, 1891, p. 657.

³⁰ Arch. f. Kinderheilk., 1906, xliii, 121.

³¹ Revue de méd., 1908, xxviii, 359.

³² Tuberculosis, 1908, vii, 155.

Age.	Cases.	Positive.	Per cent.	Negative.
6 to 9 days	12	0	0.0	12
1 to 6 years	22	11	50.0	11
7 to 14 "	148	114	75.0	34
15 to 20 "	69	63	86.0	6
21 to 30 "	137	123	87.0	14
31 to 40 "	56	52	87.0	4
41 to 76 "	16	13	81.0	3
	460	376	81.7	84

Engel and Bauer³³ also report their results in 280 children, positive cutaneous reactions occurring with progressive frequency as age advances, and varying from 13 per cent. in boys and 20 per cent. in girls, in the fourth year of life, to 56 per cent. in boys and 50 per cent. in girls between thirteen and fourteen years of age.

The relation of the percentage of positive reactions to the general frequency of infection, as revealed by autopsy, thus appears to be fairly constant. For more reliable evidence we require statistics of autopsy findings in cases which have been tested. Of such statistics I have found but comparatively little in literature, but have been able to collect 77 cases in which the conjunctival test was applied and in which the positive or negative results were confirmed in 70, or 83.33 per cent. If we exclude 5 cases in which, after negative result, autopsy revealed only obsolete tuberculous foci, and in which the reaction might not be expected to occur, the test proved reliable in over 88 per cent. of the cases. Of cases tested by the cutaneous method, I have found records of 214 which came to autopsy, in 184, or 85.98 per cent., of which the results were thereby confirmed. Finally, of 54 cases tested by subcutaneous injection, the results were proved in all.

Autopsy controls for the conjunctival method have been reported by Wolff-Eisner, Morelli,³⁴ Blum and Schlippe,³⁵ Damask, Massary and Weil,³⁶ Comby,³⁷ Bourget,³⁸ Raviart,³⁹ Hirschler,⁴⁰ Fritz Levy, Marie and Bourilhet,⁴¹ Fehsenfeld,⁴² and Goerlich,⁴³ for the cutaneous method by Aronade,⁴⁴ Massini,⁴⁵ Engel and Bauer, Regli,⁴⁶ Lemaire,⁴⁷ Gruener,⁴⁸ v. Pirquet, and Ziesche;⁴⁹ and for the subcutaneous method, by Mettetal,⁵⁰ France,⁵¹ Mikulicz,⁵² and Diehl.⁵³

³³ Berl. klin. Woch., 1907, xlv, 1169.

³⁴ Wien. klin. Woch., 1908, xxi, 83.

³⁵ Münch. med. Woch., 1908, lv, 60.

³⁶ Bull. d. l. soc. méd. d. hôp., November, 1907 (cf. Blum und Schlippe, l. c.).

³⁷ Soc. méd. des hôp., July 19, 1907 (cf. Dembinsky, Ztschr. f. Tuberkulose, 1908, xii, 138).

³⁸ Rev. méd. d. l. Suisse romande, 1907, p. 88 (cf. Blum und Schlippe, l. c.).

³⁹ Comp.-rend. soc. d. biol., 1907, lxiii, 506.

⁴⁰ Wien. med. Presse, 1907, xlviii, 1765.

⁴¹ Comp.-rend. soc. d. biol., 1907, lxiii, 281.

⁴² Münch. med. Woch., 1908, lv, 1373.

⁴³ Ibid., 1379.

⁴⁴ Med. Klinik, 1907, iii, 51 (cf. Wolff-Eisner, Beitr. z. Klin. d. Tub., 1908, ix, 64).

⁴⁵ Correspondenzblatt f. Schweiz. Aerzte, 1908, xxxviii, 359.

⁴⁶ Ibid., 361.

⁴⁷ Rev. d. l. tuberculose, n. s., 1908, v, 199.

⁴⁸ Wien. klin. Woch., 1908, xxi, 986.

⁴⁹ Berl. klin. Woch., 1908, xlv, 1168.

⁵⁰ Thèse de Paris, 1900.

⁵¹ Transactions of the British Congress on Tuberculosis, 1901, London, 1902, iii, 106.

⁵² Deut. med. Woch., 1891, xvii, 373.

⁵³ Diss. Freiburg im Breisgau, 1892.

The significance of tuberculin reactions has also been questioned, because, as shown by Matthes,⁵⁴ Freymuth,⁵⁵ Cabot,⁵⁶ and others, subcutaneous injection of peptones, albumoses, and the like induced fever and other constitutional phenomena in tuberculous and in non-tuberculous persons similar to those occasioned by tuberculin. It is to be observed, however, that such effects follow only the injection of doses much larger than those in which tuberculin is active, and, moreover, and this is of determining importance, such substances have not the selective action upon tuberculous tissue peculiar to tuberculin. In the earlier period of tuberculin therapy tuberculous patients at the Winyah Sanitarium were frequently injected with unplanted glycerin-bouillon solutions, and while fever often resulted, no focal reaction was ever observed in visible tuberculous affections of mucous membranes, nor in the lungs so far as could be determined by auscultation.

On the other hand, focal reaction has been observed to follow diagnostic injections of tuberculin with such frequency, in our experience at the Winyah, that we have long considered this as of much greater diagnostic import than the general symptoms of fever, malaise, etc. Among 23 cases with positive reaction to diagnostic injection of tuberculin, given in the Institution in 1903 and 1904, focal reaction was unmistakable in 21. In the other two the previous presence of moist rales made differentiation of the local phenomena doubtful. The significance of focal reactions to tuberculin has also been pointed out by Neisser,⁵⁷ Maragliano,⁵⁸ Schwalbe,⁵⁹ and others.

In the production of fever reactions in the tuberculous, also by subcutaneous injection of bacterial proteids other than those derived from the tubercle bacillus, as shown, for example, by Feistmantel⁶⁰ with *Streptothrix farcinia*, by Klemperer,⁶¹ and by Buchner and Roemer with proteins of *Bacillus pyocyaneus*, there is nothing surprising if the dosage is sufficient; and, as Feistmantel himself says, there is nothing which acts in its injection in minimal doses upon the tuberculous organism as does tuberculin.

The work of Irimescu⁶² with paratuberculin prepared from Moeller's Timothy bacillus for conjunctival test (alcoholic precipitate), with which he obtained 44 positive reactions to first instillations out of 45 surely tuberculous cases, is to be accepted rather as evidence of the specific nature of the test than otherwise, since it illustrates the principle of group reaction. Neither does Irimescu

⁵⁴ Deut. Arch. f. klin. Med., 1894, liv, 39.

⁵⁵ Diss. Erlangen, 1898.

⁵⁶ Journal of the Boston Society of the Medical Science, January, 1899.

⁵⁷ Klin. Jahrb. Ergänzungsband, Berlin, 1891, p. 418.

⁵⁸ Riforma medica, 1891 (cf. Münch. med. Woch., 1891, xxxviii, 149).

⁵⁹ Berliner Klinik, January, 1891, No. 31.

⁶⁰ Centralbl. f. Bakt., 1904, xxxvi, 282.

⁶¹ Ztschr. f. klin. Med., 1892, xx, 165.

⁶² Revist. Stiintel. med., 1907, Nos. 7 and 8 (cf. Centralbl. f. inn. Med., 1908, xxix, 87).

interpret his observations as showing more than the close relationship existing between tuberculins and paratuberculins.

Finally, Fernand Arloing⁶³ believes he has supplied positive proof of the non-specific nature of the reaction. Two horses which had been used to obtain antidiphtheritic serum reacted positively, as did also two horses treated with tetanus toxin, while in untreated horses the reaction was negative, but appeared after five weeks of antidiphtheritic immunization. This author's results lack confirmation, and in controversion thereto, Calmette and Guérin⁶⁴ report entirely negative results in 23 horses, 8 of which were immunized against diphtheria, 8 against tetanus, and 7 were non-immune. By the cutaneous method Entz⁶⁵ has obtained reactions in tuberculous adults and children to toxins other than tuberculin, as diphtheria, pyocyanus and paratyphoid, in about 50 per cent. of cases.

To his denial, based upon these results, of the specific nature of the tuberculin test von Pirquet replies that, on the one hand, it has been shown for some toxins (mallein, leprolin, vaccin, tuberculin) that the organism will only then react to them if there has been a previous infection with the reciprocal microorganism; that, on the other hand, with other toxins (tetanus, diphtheria) such a previous infection ("acquaintance") is not necessary or essential to the reaction. These facts, he says, do not invalidate the specific nature of the cutaneous tuberculin test.

That non-specific protein substances are incapable of causing conjunctival reactions, Roepke ascertained in 25 tuberculous patients by instilling a 5 per cent. solution of glycerin bouillon which had first been condensed to one-tenth of its volume and then diluted. No effect was produced. I have also instilled a control preparation consisting of a 1 per cent. solution of the alcoholic precipitate of concentrated glycerin-bouillon into the conjunctival sac in 15 cases, 8 of which had previously given positive reactions to tuberculin, the same eye being used, without in a single instance observing the slightest influence, either general or local.

On the other hand, I have observed in several early cases of apex localization a focal reaction to occur simultaneously with the conjunctival reaction; the stethoscopic signs became distinctly intensified, and crepitation was heard where it had before been absent. Roe⁶⁶ also reports a case tested by the conjunctival method in which the occurrence of focal reaction in the lung cleared up the diagnosis, which had before been doubtful.

This would indicate that the tuberculous focus is concerned in the reaction. I cannot believe, therefore, that the latter depends upon the local formation of antibodies alone. With the minimal doses in which tuberculin is thus applied, 1 to 4 mg. (exceptionally),

⁶³ Comp.-rend. soc. d. biol., 1908, lxiv, 722.

⁶⁵ Wien. klin. Woch., 1908, xxi, 379.

⁶⁴ Ibid., 889.

⁶⁶ Brit. Med. Jour., 1908, i, 443.

according to the strength of solution employed, part of which is, moreover, often not even retained in the conjunctival sac, it is not conceivable that enough would be absorbed into the circulation to produce manifest and recognizable focal reaction in a majority of cases, as is so frequently observed after subcutaneous injection of tuberculin.

Further than this, for lack of space, I must refrain from entering into a consideration of the various theories which have been advanced in explanation of the conjunctival and cutaneous reaction, and of the divergent comparative results therewith obtained. So far as I can judge, none has as yet been formulated which satisfactorily meets all requirements and is entirely free from objection.

Among the specific aids in the diagnosis and prognosis of tuberculosis I have still to consider the serum reactions, and more particularly the agglutination reaction of Arloing and Courmont, with which my own experience is more extensive.

As regards the value of these methods, there still prevails a wide diversity of opinion. It was not long after Arloing and Courmont's first publication before the diagnostic significance which they claimed for the sero-agglutination of tubercle bacilli was disputed by other observers, because it was found that not only was the reaction inconstant in tuberculosis, but that it occurred occasionally in other affections, notably typhoid fever, and with the serum of healthy individuals.

Such experiences have caused many to deny that the test has any diagnostic value whatever, among whom may be cited Eisenberg and Keller⁶⁷ who noted but 13 per cent. more positive reactions in tuberculous than in non-tuberculous persons; also Dieudonné,⁶⁸ Beck and Rabinowitsch,⁶⁹ v. Gebhard and v. Torday,⁷⁰ de Grazia,⁷¹ and lastly Wright and Douglas,⁷² who state that the demonstration of the agglutinating power of serum affords no information of the presence or absence of tuberculosis.

Ferré,⁷³ Kinghorn,⁷⁴ Bendix,⁷⁵ Bandelier, and others find that in advanced cases of tuberculosis the reaction is often absent or is less pronounced.

Rumpf and Guinard⁷⁶ found the reaction positive in 84 per cent. of 107 cases, and Carrière⁷⁷ in 75 per cent. of second- and third-stage cases of phthisis. Berthelon⁷⁸ obtained 96 per cent. of positive results in pulmonary tuberculosis, many sera reacting in dilutions

⁶⁷ *Centralbl. f. Bakt.*, 1903, xxxiii, 549.

⁶⁸ *Deut. Militärärztl. Ztschr.*, 1900, No. 10.

⁶⁹ *Transactions of the British Congress on Tuberculosis*, 1901, London, 1902, iii, 153.

⁷⁰ *Münch. med. Woch.*, 1902, xlix, 1171.

⁷¹ *Berl. klin. Woch.*, 1902, xxxix, 229.

⁷² *Lancet*, 1904, ii, 1138.

⁷³ *Ann. d. méd. et chir. infant.*, 1906, x, 648.

⁷⁴ *Medical News*, 1905, lxxxvii, 647.

⁷⁵ *Deut. med. Woch.*, 1900, xxiv, 224.

⁷⁶ *Deut. med. Woch.*, 1902, xxviii, 131.

⁷⁷ *Comp.-rend. soc. d. biol.*, 1901, liii, 746.

⁷⁸ *Congrès internat. d. l. tuberc.*, 1905, Paris, 1906, I, 359.

of 1 to 15, 1 to 20, and even some as high as 1 to 50. Hawthorn⁷⁹ reports 54 positive reactions out of 57 cases, and failed to obtain positive results in healthy individuals, although, in his experience, the reaction occurred in other diseases. Romberg⁸⁰ found no agglutination in 33 newborn infants, nor did Descos,⁸¹ whether the mothers were tuberculous or not. Rosenberger⁸² obtained complete reaction in dilutions of 1 to 1 in three, and of 1 to 3 in one, or in a total of 4 out of 39 newborn infants.

At the Winyah Sanitarium I have studied the subject for several years, applying the test on admission, and at intervals during treatment with specific remedies. Observations in 300 tuberculous cases which are complete show the following results:

				Cases.
On admission the test was negative in	.	.	.	20
Agglutination occurred in dilution of 1 to 5 in	.	.	.	49
"	"	"	1 to 10 in	86
"	"	"	1 to 15 in	21
"	"	"	1 to 20 in	50
"	"	"	1 to 25 in	57
"	"	"	1 to 30 in	7
"	"	"	1 to 40 in	4
"	"	"	1 to 50 in	6

In the same cases, on discharge the results were as follows: In 288 cases an increase of agglutinating power was observed under treatment with watery extract of tubercle bacilli. The serum of 63 agglutinated in dilutions of over 1 to 25, and not exceeding 1 to 100. Of these, 6 (or 9.35 per cent.) were apparently cured; the disease was arrested in 22, or 34.92 per cent.; improved in 27, or 42.85 per cent.; stationary in 6, or 9.35 per cent.; and had become worse in 2, or 7.4 per cent. The serum of 107 agglutinated in dilutions of over 1 to 100 and not exceeding 1 to 200. Of these, 41 (or 38.32 per cent.) were apparently cured; the disease was arrested in 51, or 47.66 per cent.; improved in 14, or 13.08 per cent.; stationary in 1, or 0.94 per cent.; and had grown worse in none. The serum of 90 agglutinated in dilutions over 1 to 200 and not exceeding 1 to 300. Of these, 73 (or 81.11 per cent.) were apparently cured; the disease was arrested in 15, or 16.76 per cent.; improved in 2, or 2.22 per cent.; stationary in none; had grown worse in none. The serum of 28 agglutinated in dilutions over 1 to 300 and not exceeding 1 to 500. Of these, 25 (or 85.7 per cent.) were apparently cured; the disease was arrested in the remaining 3, or 14.3 per cent. In the additional 12 cases a decline in agglutinating power was noted in 8, and a total loss in 4; all the 12 patients grew worse or died.

These observations are quite in accord with the experience of others. In 20 of our cases in which the diagnosis could be otherwise

⁷⁹ *Gaz. hebdom. d. méd. et d. chir.*, 1902, vii, 547.

⁸⁰ *Münch. med. Woch.*, 1902, xlix, 89.

⁸¹ *Jour. d. physiol. et d. path. gén.*, 1903, v, 127.

⁸² *Zentralbl. f. inn. Med.*, 1904, xxv, 665.

established no agglutinating power was present, while in 49 it did not exceed a dilution of 1 to 5. Again, in far advanced progressive cases the reaction either disappeared entirely or became progressively diminished.

Arloing and Courmont⁸³ subsequently to their earlier publications, decided that agglutination in dilutions below 1 to 5 should not be accepted as diagnostic, since the reaction was often present in healthy persons in such slight degree. My own experience would confirm me in the opinion that, in the absence of other definite evidence upon which to base a diagnosis, we should require a positive reaction in dilutions of not less than 1 to 10; this, because I have frequently observed reaction in lower dilutions in persons in whom suspicion of tuberculosis did not exist. With this qualification, of the 300 cases examined, 231, or 77 per cent., agglutinated in dilutions of 1 to 10 or higher, and in all the diagnosis was either sufficiently evident or could be determined by other means. In cases in which there is no sputum, or in which tubercle bacilli are absent, and in which the subjective symptoms and physical signs denote apex infiltration or catarrh, I have learned to depend upon the reaction when present in the higher dilutions as of positive determining value, and in such cases the tuberculin test may be dispensed with, its results in my experience always having confirmed those of the serum test.

The occurrence of agglutination in slight degrees in health does not detract from the value of the method in clinical practice. The facts that the reaction is frequently absent in the early period of the disease, that it is rarely missed when the disease is more developed, and is again diminished or lost toward the end, show that agglutinins form in the course of tuberculosis, as in other infectious diseases, in response to the absorption into the blood of specific toxins. The amount of agglutinins varies materially with the amount of specific toxins absorbed and the corresponding degree of response on the part of the organism. Hence it is that in the more developed disease we find the reaction most constantly present when the general condition and general resistance are still good. When these are greatly diminished in rapidly progressive cases the ability to respond is likewise lessened and the agglutinating power in consequence declines or is entirely lost.

The occurrence of the reaction in many healthy persons and in those affected with other diseases may be interpreted by assuming that latent foci exist in those who show slight degrees of agglutinating power, and in consequence of which they have acquired it.

The fact that the sera of newborn children are practically always negative, associated with the extreme rarity of congenital tuberculosis on the one hand, and on the other the great frequency with

⁸³ Congrès internat. d. l. tuberculose, 1905, Paris, 1906, 1, 332.

which latent and healed tuberculous foci are revealed at autopsy on the clinically non-tuberculous, renders more than probable the truth of such an explanation.

The greater comparative frequency with which the reaction occurs in cases of typhoid fever appears to bear an analogy to the recorded experiences with the tuberculin test in such patients. Thus, in a total of 70 typhoid fever cases, in which tuberculin was instilled into the conjunctival sac by various observers, positive reactions occurred in 20 or 28.37 per cent., as detailed below.

CONJUNCTIVAL TUBERCULIN TEST IN TYPHOID FEVER.

Author.	Cases.	Positive.	Negative	Preparation; Remarks.
Blum	18	4	14	9 had fever. Calmette's formula.
Austin and Gruenbaum ⁸⁴ .	8	0	8	Calmette's formula.
Clark ⁸⁵	14	7	7	T. old 0.5%. All fever cases.
Cohn, Sigism	11	6	5	T. old 1.0%. 1 positive case was paratyphoid; 4 afebrile.
Levy, Fritz	3	1	2	T. old. Hoechst. Convalescence.
Stadelmann and Wolfi-Eisner .	8	0	8	All negative to cutaneous.
Tice ⁸⁶	7	1	6	Tablet form.
Bourget	1	1	0	Autopsy negative as to tubercu- losis.
	70	20 28.37%	50	

Again, according to Arloing and Courmont, typhoid fever patients show agglutinating power for the tubercle bacillus in 75 per cent. of cases.

From this Calmette and Guérin infer that the Eberth bacillus forms agglutinins which are capable of agglutinating both kinds of bacilli, but Arloing and Courmont claim that this occurrence is not due to the identity of the two agglutinins, nor to a parallel method of production. The serum of an animal, they say, may acquire a high agglutinating power for the Eberth bacillus after inoculation with this bacillus, without exhibiting the like characteristic for Koch's bacillus.

This question is an interesting one, and engaged my attention some ten years ago in a comparative study of the agglutinating power of the blood sera of normal individuals and of tuberculous patients in relation to the Eberth bacillus. In my own experiments I used for control serum from typical cases of typhoid fever, which was found to agglutinate completely the Eberth bacillus in dilutions of 1 to 10 in fifteen minutes. The sera of normal persons who had never had typhoid fever, and who

⁸⁴ Brit. Med. Jour., 1907, ii, 1907.

⁸⁵ Jour. Amer. Med. Assoc., 1908, 1, 2061.

⁸⁶ Ibid., 1982.

were free from all suspicion of tuberculosis, showed no tendency to agglutinate the Eberth bacillus even after one hour. As compared with the normal and with typhoid sera, the sera of tuberculous patients with no history of typhoid fever showed beginning agglutination of Eberth's bacillus in fifteen minutes and well marked agglutination in thirty minutes in the same dilution.

The only explanation for these observations, and one which may be applied with as much reason to account for tuberculin reactions in typhoid fever patients in greater frequency than these occur in healthy persons, appears to lie in that of group reaction, even though the Eberth bacillus seemingly presents nothing in common with the acid-proof bacteria. However that may be, no definite conclusions are warranted.

In this consideration of specific aids in the diagnosis and prognosis of tuberculosis I have endeavored to show the comparative value of the various resources at hand.

The specific nature and value of tuberculin as a diagnostic agent does not appear to be refuted by the objections which have been raised against it. The minimal amounts in which it is active, the negative results obtained by all three methods of applying it in the newborn, the increasing comparative frequency of positive reactions with advancing age in their approximate harmony with autopsy findings in the clinically non-tuberculous as well as the tuberculous, the occurrence of focal reactions following subcutaneous injection and conjunctival instillation, all testify to its reliability.

To demand that either positive or negative results be confirmed with mathematical accuracy by actual autopsy findings would be unreasonable; nor has clinical medicine progressed to such a degree of precision in other respects.

As much may be said for the serum reactions. As for the various contradictions which have apparently arisen with regard to all the diagnostic measures which have been considered, and which are at present not explained, these are problems which may yet be solved in the future.

In clinical practice the occasion can seldom arise to enter so deeply into such questions. Persons who are in good health do not often consult a physician, nor would any but the most unconservative base a diagnosis upon a single isolated bit of evidence. In non-bacillary cases suspected of tuberculosis, when physical examination reveals abnormal conditions suggestive of the presence of a tuberculous affection, the tuberculin test as well as the serum reaction, or both, may safely be depended upon for confirmation in the vast majority of instances. One may be employed to supplement the other, and thus, taking all things into consideration, the patient is not likely to be placed at a disadvantage for want of a diagnosis.

SOME ASPECTS OF CALCULOUS ANURIA.

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THERE are certain factors connected with the condition of calculous anuria concerning which there is a general agreement among surgeons and pathologists; these I shall merely enumerate. There are others which have either received but relatively slight attention or concerning which there is a difference of opinion; it is with some of the latter only that this communication is concerned.

The following belong to the first of these two classes:

1. In the majority of the cases of unilateral calculous anuria the unobstructed kidney is either destroyed, functionally useless, or there is a congenital absence of the organ on the side opposite that of the obstructed kidney.

2. The average time of the period of tolerance, so-called, that is the time which elapses between the beginning of the anuria and the appearance of uremic symptoms, is from five to seven days. The number of days before death occurs after the appearance of uremic manifestations is variable; so, too, is the length of time between the beginning of the anuria and death. Twenty-three days have been reported to have intervened between these times in one instance, and there are a number of cases in which death has not taken place before the sixteenth day.

3. The mortality in the cases of patients treated palliatively is very great (between 70 and 80 per cent.); that of those treated surgically is about one-half as great.

4. The nearer the beginning of the anuria the surgical treatment is applied, the smaller is the mortality attending the operations and the larger the number of patients who recover. It is, however, true that the presence of uremic manifestations, and the fact that the period of anuria has been very long, do not constitute contra-indications to operation; nor is surgical treatment necessarily hopeless under these conditions.

5. Surgical intervention should not be delayed more than forty-eight hours, and in some cases the delay should be less.

6. Absence of uremic manifestations and an apparently good condition of the patient do not excuse a longer delay than this in applying surgical treatment.

7. The essential indications to be fulfilled in the surgical treatment are to supply a free avenue of escape for the urine from the kidneys, and, if the patient's condition permits, to remove the calculus.

8. The first kidney to be operated upon should be the one which is believed to be the less damaged of the two.

9. The quickest and most effectual way of restoring the sup-

pressed urinary function of an obstructed kidney is by a rapidly performed lumbar nephrotomy and drainage of the organ for a time at least afterward.

The factors of the second class spoken of are as follows:

1. *The reno-renal reflex inhibition of the function of an unobstructed kidney produced by the sudden obstruction of the uterer of the kidney of the opposite side.*

It is frequently denied that this phenomenon can occur when the unobstructed kidney is normal, but that it may do so appears to be established by the clinical observations reported by Imbert, Israel, Kreps, Røvsing, and Broca, and by one postmortem examination reported by Legueu. It is undoubtedly very rarely that such an inhibition occurs in the unobstructed normal kidney, but what is not sufficiently remembered, although almost equally important, is the undoubted fact that the function of an unobstructed and more or less diseased or damaged kidney, which, however, retains a useful degree of functional capability, is frequently inhibited by what we call a reno-renal reflex. Moreover, there is a certain number of cases in which both kidneys retain a useful degree of functional activity, and in which the united work of both will be required to maintain the life of the patient, and in which neither one alone is capable of doing so. For these reasons we may not rely upon the oft-repeated dictum of Legueu with reference to calculous anuria: "Anuria does not occur except in patients who live with one kidney only."

The two following cases are of interest in connection with the question of the reno-renal reflex inhibition of the unobstructed kidney, and illustrate some of the points that have just been spoken of. The first was a case reported by Ransohoff, in which anuria was not present at the time the patient was subjected to a right-sided nephrolithotomy. The kidney was the seat of a suppurative process, but was still capable, as it afterward proved, of performing a very essential and useful degree of functional work. It was drained. Both kidneys continued to secrete for the next month, the lumbar drainage from the kidney already operated upon being maintained during the whole of this time. At the end of a month the other kidney became obstructed and anuria occurred. At the end of the third day of the anuria the second kidney was laid open. It was pyonephrotic, but still capable of performing useful functional work. This kidney was likewise drained. Both kidneys at once resumed their function. The first kidney operated upon performed two-thirds, and the second kidney one-third, of the total functional work of secretion. The two organs were permanently drained through the loins. The patient was in good condition at the time at which the report was made, three years after the second operation.

The second case is one personally communicated to me by Dr. Hugh Cabot. Anuria was not present at the time of the performance

of a unilateral nephrolithotomy. The kidney was drained through the loin, when, on the fourth day after the operation, anuria occurred. Dr. Cabot promptly cut down upon the second kidney and removed an obstructing calculus from its ureter. Both kidneys resumed their secretory function; the wounds healed in due course, the patient recovered, and was in excellent health eight months after the second operation. Neither kidney was normal in this case, but both were capable in a useful degree.

In this case, as in the first, there seems to be no way of explaining the suppression of the function of the kidney first operated upon except by assuming that it was produced by a reno-renal reflex inhibitory influence proceeding from the sudden obstruction of the ureter of the opposite kidney. The chiefly interesting point in both of these cases is that the suppression of function should have occurred at the moment when the kidney of the side first operated upon was draining freely through the loin. Another point to be noted is that the united work of both kidneys was required to sustain life in both of these cases, and that both kidneys in both cases were in a useful degree functionally capable, although neither of them was normal. It may be questioned whether the inhibitory influence was of the nature of a reno-renal reflex, but it cannot be doubted that whatever its nature may have been, it was, at any rate, such that the arrested renal function was set free again by virtue of providing an outlet for the escape of urine directly from the obstructed organ, and the patients' lives were thereby saved. This last fact is the one to be borne in mind from the standpoint of the practical surgeon, and it is that which should determine prompt action on his part in these cases.

2. *The differences which may exist between the renal conditions seen upon postmortem examination of the kidneys and those which may have been present at the beginning of the anuria, and the impossibility of asserting positively just what degree of structural change in a kidney necessarily renders it wholly incapable of further functional work.*

With regard to this point, it need only to be recalled that the changes of a destructive nature in the secreting elements of a kidney which is wholly obstructed, progress rapidly, and that it is not necessarily true that the renal conditions which at the time of postmortem examination may be such as to suggest that the kidneys could no longer be capable of useful functional activity were necessarily incapable at the time of the beginning of the attack of anuria. Equally is it impossible—except in the examples of extreme destruction of the kidneys—to state positively just what degree of destruction of renal substance must necessarily deprive a kidney of any further functional activity of a useful character. Most surgeons have operated upon kidneys in which there has been so small a layer of renal secreting substance as to make it

seem impossible that the organ should be capable of performing any useful degree of functional work, and yet in some of these cases the operator has been surprised to find that the patient not only continues to live, but may even enjoy a long period of good health. In such a case as this it is very possible that the conditions which were present at the beginning of the attack of anuria would have been such as to have allowed the patient to live had there been supplied a free escape for the urine from the kidney shortly after the attack began, and yet at the time of death, at the end of a considerable period of anuria, the kidney may present such conditions as to make restoration of functional activity impossible—at any rate, to the point of maintaining the patient's life. The practical lessons to be learned from these things is that the surgeon should operate early in the course of the anuria, and that he should be wary of assuming that a kidney, even when it possesses but a very small amount of renal secreting substance, is necessarily useless.

3. *The advantages that may sometimes be derived from simultaneous bilateral nephrotomy or nephrolithotomy in calculous anuria.*

The patient with calculous anuria needs most urgently to have all the capable renal substance of which he is possessed set at liberty to become again active if he is to be given the best chance of having his life saved. If the statement which has been quoted from Legueu, "Anuria does not occur except in patients who live with one kidney only," is true, it is obvious that it would be useless ever to incise the second kidney at, or soon after, the time of incising its fellow of the other side (unless it be in the cases in which the mistake has been made of laying open the wrong—useless—kidney in the first instance), for we should not be accomplishing any good whatever. If, on the contrary, there are cases in which both kidneys possess a useful degree of functional activity, and if, furthermore, the functional work of one of them alone is insufficient to sustain life, and if, on the other hand, it is capable of being maintained by the combined action of such renal substance as may be present and still capable in both kidneys, it is equally clear that in all the instances in which these things are true we shall not be giving the patient his best chance of life if we arrest our intervention with a unilateral operation, and that we should proceed to incise both kidneys at one and the same sitting.

It is for this reason that I urge that simultaneous bilateral nephrotomy or nephrolithotomy be done in some of these cases. Those in which I think this procedure is appropriate are the following: (1) All cases in which, upon cutting down upon the first kidney, it is found that there is not enough renal substance remaining to make it probable that the organ will be capable of sustaining life by the exercise of its function alone. The inference should always be that the greater the destruction in the kidney first operated upon,

the greater the probability that the kidney of the other side has a useful amount of renal secreting substance in it, and correspondingly greater becomes the importance of immediately incising that kidney, in order that the patient may have the benefit at once of all the functionally capable renal substance that he possesses. (2) All cases in which there is a simultaneous blocking of the ureters of both kidneys, or in which there is one ureter blocked and a calculus in the other kidney, it being always possible and fairly probable that the calculus in the second kidney, even though it is not at the moment blocking the ureter, may do so at any time subsequently.

The frequency with which calculous disease is bilateral may be judged from the 230 cases of renal calculus made up of the separate series published by Albarran, Morris, Legueu, Kraft, and Kimmel: in 30 per cent. of these, calculi were present in both kidneys. In another series of cases that I collected, numbering 187, there were 52 (27.8 per cent.) of bilateral calculus, and in 29 of these there was simultaneous blocking of the two ureters. It is in the latter class that there is the greatest likelihood of capable renal substance being present in both kidneys.

The *x*-ray examination and radiography are, of course, our best means of determining the presence of a calculus in the kidneys or ureters; but in this special class of cases the patient is very critically ill—which makes such an examination difficult; an expert in making radiograms may not be available, and it may not be justifiable to delay to have such an examination made; consequently, we are frequently deprived of the assistance that we should otherwise have from it. This is often true also of the employment of the ureteral catheter. There may be, however, a great advantage derived from passing the ureteral catheters into the ureters, not merely for the purpose of detecting the presence of a calculus, but also to relieve—at least temporarily—the anuria, by passing the instrument beyond the stone, and thus overcoming the obstacle to the free escape of urine from the kidney. When this is successful the surgeon is given a better chance for removing the calculus subsequently under more favorable conditions than those which he faced at the outset. The ureteral catheter, however, should not be relied upon to secure permanent relief from the danger of anuria.

Returning to the consideration of the advantages of simultaneous bilateral nephrotomy or nephrolithotomy in some of the cases of calculous anuria, I would say that I have found but 6 cases in the literature in which this operation has been done in this class of cases. These are as follows: Lange, Turner, Macmunn, Moschkowitz, Watson, and Babcock. The patients of Lange, Moschkowitz, and Babcock lived; the other 3 died. It is, however, to be noted that in the cases of Turner and Watson the deaths were due to sepsis rather than to a failure of restoration of renal function.

Reference and name of reporter.	Duration of anuria and uremia.	Operation and result.	Condition of kidneys.
Lange (<i>Med. News</i> , January 16, 1886, p. 96).	Anuria 24 hours.	Simultaneous bilateral operation. First kidney incised was functionally useless. Calculus removed from second kidney; the latter was functionally capable. Recovery.	First kidney incised was hydronephrotic and functionally useless. The second one contained a calculus and was capable.
Ransohoff (<i>Jour. Amer. Med. Assoc.</i> , 1895, xxv, 1).	Anuria not present at time of first operation; 3 days before the second.	Bilateral nephrectomy. Stone removed from the first kidney. None in second, but a collection of pus was evacuated. Both kidneys drained permanently. Patient in good condition 3 years after operations. One month's interval occurred between the two operations. Recovery.	Both kidneys pyonephrotic. Both capable. Neither one alone was sufficient to have maintained life.
Albarran (from <i>Huck's Thesis</i> , Naucy, 1904).	Anuria present; duration not stated.	Unilateral nephrectomy on unobstructed kidney. Kidney drained for 24 days; it then ceased to secrete. No operation done on other side. Death.	First or unobstructed and operated kidney was merely congested and enlarged. The second one, which was not operated upon, had calculus obstructing ureter.
Stevens (from <i>Huck's Thesis</i>).	Anuria 8 days; uremia none.	No operation. Death.	Both ureters obstructed by calculi. One kidney nearly normal. The other had some functionally capable substance.
Vitrac (from <i>Huck's Thesis</i>).	Anuria 9 days.	Unilateral nephrectomy. Death 4th day from uremia.	Both ureters blocked by calculi. Both kidneys had a good deal of capable secreting substance.
Bruch (<i>Huck's Thesis</i>).	Anuria 8 days.	Unilateral nephrectomy. Death 2d day.	Same as in preceding case.
Huck (<i>Thesis</i>).	Anuria 10 days.	Unilateral nephrectomy.	Both kidneys had useful amount of capable renal substance. Both ureters blocked by calculi.
Babcock (<i>Ann. Surg.</i> , April, 1908).	Anuria 24 hours. No uremia.	Simultaneous bilateral nephrolithotomy. Recovery. The same operation had been done 3 years before.	Both ureters blocked. Both kidneys functionally capable in useful degree. One of them had moderate hydronephrosis.
Thomas (<i>Rev. med. la Suisse Rom.</i> , 1906, xxxvi, 639).	Anuria 15 days; two slight remissions. Uremia unnoted.	Unilateral nephrectomy 15th day of anuria. Death 3 days later.	Both kidneys had a useful amount of capable secreting substance. Both had moderate degree of interstitial nephritis. Recent infarctions in kidney not operated upon. Both ureters blocked.
Doering (<i>Dent. Zisch. f. Chir.</i> , 1907, lxxxi, 66).	Anuria 8 days. Uremia unnoted.	No operation. Death 8th day of anuria.	Both ureters blocked. Recent parenchymatous nephritis.
Doering (<i>ibid.</i>).	Anuria 10 days. Uremia unnoted.	Unilateral operation begun, but not completed. Death.	Recent hemorrhagic inflammation in both kidneys. Both ureters blocked by calculi.
Moschcowitz (<i>New Yorker med. Monatsschr.</i> , 1904, xvi, 401).	Anuria 2 days.	Later, bilateral ureterolithotomy, with an interval between the operations. Recovery. Cure.	Both ureters blocked. Both kidneys capable.
Addy (<i>Marit. Med. News</i> , Halifax, 1903, xv, 374).	Anuria 26 hours.	No operation. Spontaneous expulsion of calculus. Recovery.	Both kidneys were capable.
Watson (<i>Ann. Surg.</i> , September, 1907).	Anuria 3 days. Uremia 36 hours.	Simultaneous bilateral nephrolithotomy. Death 3d day afterward. Urinary secretion was re-established. Death due chiefly to sepsis.	Pyonephrosis and perinephritic abscess of both kidneys. Both ureters blocked by calculi.
Turner (<i>Trans. Clin. Soc. London</i> , 1891, xxiv, 151).	Anuria 24 hours. Uremia same.	Same as in last case. Death 5th day. Same operation.	Both kidneys pyonephrotic. Both ureters blocked by calculi.
MacMunn (Quoted by Morris, <i>Renal Surgery</i> , 1898, p. 287).	Anuria, uremia, both unnoted.	to sepsis chiefly.	Neither kidney functionally capable. This case is one in which the fact of finding the first kidney operated upon incapable should, as it did, lead to the immediate incising of the other one, but in this special instance the combined work of both was not enough to save the patient.

The indications for the simultaneous bilateral operation in unilateral cases of calculus have already been stated. It would not be appropriate to do this operation in any case in which the surgeon judged that the first kidney operated upon would probably be capable, by its own unaided work, of sustaining the life of the patient, but only when the contrary is true.

The additional shock involved in the operation upon the second kidney, when it is done at the same time as the operation upon the first, is but little greater than that of the unilateral operation, so far as we may judge from my experience up to the present time. Both organs can be incised and drained very quickly, unless there are unusually difficult conditions present, such as adhesions, that necessitate a longer and slower procedure. It is true that any surgical intervention of magnitude, such as nephrotomy, carries with it a very considerable danger to life when it is undertaken under conditions such as those under consideration; but the condition, left to itself or but partially relieved, is far more dangerous than the complete operation is ever likely to be in the cases in which I have suggested the employment of the bilateral procedure.

The appended table of 16 cases is taken from the whole number of 33 in the series of 187 cases which I collected, and in which I believe that the renal conditions were such as would have made the simultaneous bilateral operation better than the unilateral one. The latter was practised in all but 6 of the cases (those already referred to); in 4 others a bilateral operation was done, with an interval between the two procedures. These 4 cases were those of Cabot, Kümmel, and Ransoboff. All these patients lived; in none of them was there a simultaneous blocking of the two ureters, while in the other 6 it was present. The renal conditions were also more favorable in the 4 than in the 6 patients. In no single instance in which a unilateral operation alone was done, did the patient live.

THE IMPORTANCE OF MODIFICATIONS OF THE SENSIBILITY IN THE DIAGNOSIS OF DISEASE.

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MANY of the difficulties in the examination of the sensibility were inherent in the imperfect methods due to a former want of knowledge of the different modalities of this function. These have been solved by the researches of Head¹ and his colleagues,

¹ Brain, 1905, xxviii, 99, 115.

who have shown that there are three distinct and different modes in the periphery. These are not, as it was formerly thought, touch, temperature, and pain, but consist of:

1. *Deep Sensibility*. The fibers subserving this originate in the muscle spindles and analogous bodies, and accompany motor nerves and those in tendon, joint, and connective tissue in general. They are stimulated by molar alteration of relative pressure and are expressed in terms of pressure and attitude. They are also susceptible to vibration, and when powerfully stimulated transmit painful impulses. Symptomatically, their involvement causes ataxia and partial astereognosis.

2. *Epicritic sensibility*, passing by the cutaneous nerves and conveying impressions of (a) light touch, (b) fine distinctions of coolness and warmth, (c) the appreciation of two or more spots touched simultaneously, along with localization.

3. *Protopathic sensibility*, by which one perceives only the extremes of heat and cold, and by which, although tactile and painful impressions are perceived, they seem vague and are badly localized, being often referred to other parts of the body or even to the exterior.

Head² believes that it is this form of sensation which is stimulated in visceral disease, and he lays stress upon the discomfort of an inexplicable kind which often accompanies stimulation of these fibers. It is manifested especially on hairy parts on lightly drawing a needle across a part retaining only protopathic sensations, and resembles the feeling of shivers many people experience upon hearing or feeling the rubbing of silk or the squeaking of a door. Of all our sensations, this is probably the least differentiated phylogenetically. Head thinks it is probably that part of the afferent arc which expresses itself efferently in the pilomotor, vasomotor, and secretomotor reflexes. This, unlike the epicritic system, does not contain specific end-organs for heat and for cold. Recent researches of Gordon Wilson³ indicate that it is the only system represented in the cutaneous tympanum, which contains no end-organs and is insensitive to touch, coolness, and warmth.

This is the form of sensibility which Sherrington⁴ was investigating when he demonstrated the enormous overlapping of the distribution of cutaneous nerves. The areas of supply of epicritic nerve-groups do not encroach at all upon neighboring territory.

To Head's belief, however, MacKenzie⁵ cogently urges that viscera do not respond to any of the methods of stimulation which are effective in provoking protopathic sensations in the cutis. He inclines to believe that their sensations are autonomic, and ascribes our occasional consciousness of them to the erethism their stimulation

² Brain, 1905, xxviii, 116, 338.

³ Reports of the Hull Laboratory of the University of Chicago, 1907.

⁴ Schäfer's Text-book of Physiology, 1900.

⁵ Brit. Med. Jour., 1906, p. 1449.

causes in a metamere to which their sympathetic afferent nerve fibers run. The erethism thus induced is manifested when one stimulates other afferent neurones of this segment, as touching the skin or pinching the muscles subserved by it, or even by a general stimulus of the whole spinal cord, as when startled. The commotion thus caused, though having little general effect, yet activates as a match to powder any area at high tension. Familiar examples of this high tension are seen in rabies, tetanus, strychnine poisoning, and spastic paraplegia, all characterized by a very slight stimulus producing a very great reaction.

The most striking example of such erythism is afforded in angina pectoris, in which the visceral spasm leads to an erethism of the eighth cervical and first and second thoracic spinal segments, resulting in an irradiation of pain along their sensory distribution, and a hyperalgesia over the same part. A reflection of a purely autonomic kind may be produced in the same region by rubbing the skin of the mamma with flannel—when a peculiar creepy sensation runs from the chest down the inside of the arm. This is often accompanied by a pilomotor contraction in the same region and by a dilatation of the homolateral pupil, and occasionally by a similar sensation on the cheek. By means such as these we can effectually exclude suggestion in interpreting the sensations, and thus remove them from the domain of hysteria, already too greatly burdened.

While these are the modalities of the sensibility distinguishable in the periphery, the groupings are very different within the spinal cord, where all painful impulses run together heterolaterally in Gowers' tract, very closely accompanied by the impulses of cold and heat. The impulses derived from the position of the limbs of which we become conscious pass homolaterally in the posterior column, while those of which we are unconscious, but which regulate tonus and automatic involvement, pass toward the cerebellum homolaterally in the dorsal spinocerebellar tract and heterolaterally in the ventral spinocerebellar tract and in the tractus spinothalamicus et tectalis. The impulses for touch, here accompanied by pressure, also take two courses, a homolateral in the posterior column for a few segments only, and a heterolateral probably in the anterior column (Page May).⁶

METHODS OF INVESTIGATION IN PRACTICE. 1 *Epicritic Sense*:

(a) By drawing soft cotton-wool over the skin; (b) by localization; (c) by a pair of compasses; (d) by test-tubes between 22° and 47° C.

2. *Protopathic Sense*: (a) By test-tubes nearer the freezing and the boiling points; (b) by the prick of a pin; (c) by an iron-cored faradic current.

3. *Deep Sensibility*: (a) By pressure on the part; (b) by altering the attitude of the limb and asking the patient to describe or imitate

⁶ Brain, 1906

the new position; (c) by the estimation of weights (muscular sense); (d) by the estimation of deep pain with the algometer. The tuning fork affects all these modes, and they are all necessary in stereognosis.

4. *Cerebellar Sense*: (a) By the chair-mounting test; (b) by the diadokokinesis; (c) by the revolving platform; (d) by the static equilibrium test.

Another law influencing sensory modifications is that of homolaterality. Lebar and Jacquet⁷ have shown that a hemihyperesthesia may occur during acute inflammation of any part of the body, and that it may be transferred to the opposite side by the intervention of a more severe inflammation at the reverse side of the body; for example, a fulminating focus of pleuropulmonary tuberculosis may be accompanied by an intense hemihyperesthesia; the breaking out of a focus in the opposite lung, or even the eruption of a wisdom tooth, may transfer the hyperesthesia to the opposite side. The characteristic implication of the platysma myoides muscle enables one to exclude the role of suggestion in these cases.

These considerations make, perhaps, only more needful the precautions against the influence of suggestion upon both patient and examiner while examining the sensibility, while they in no way invalidate the physiological law of summation, and the psychological law of rééducation, on account of which it is the first examination of the patient which is of paramount importance; and though they render the success of simulation more difficult, yet it becomes a more delicate task to unmask a trickster who is well instructed and clever (Bernheim⁸).

Experience teaches the neurologist to view with the greatest scepticism all evidence depending upon the statements of the patient, knowing empirically how they are fallacious even when without intent to deceive; and knowing psychologically that this must be so, on account of the very defective power of observation and introspection of the untrained laity. Some of the traps devised are: (1) La piège du peaucier de Jacquet; (2) Mankopf's pulse sign; (2a) pupil dilation sign; (3) simultaneous pressure trap; (4) faradic current trap; (5) counting touches; (6) diversion of attention.

CLINICAL TYPES: *Cerebral Anesthesia*. (Déjérine,⁹ Roussy¹⁰). Organic hemianesthesia may resemble that of functional type when the lesion is situated in the cortex, corona radiata, thalamus, or lemniscus; that is to say, the defect will involve all modalities of sensation in the same area; but the organic form differs in its incompleteness, being most marked at the extremities and in the fact that it passes or falls short of the middle line, although the loss of sensibility there is only partial. When the lesion is near the optic thalamus, hemianopsia may occur. It is always accompanied by

⁷ Thèse de Paris, 1906.

⁸ L'Hypnotisme et la suggestion, 1891.

⁹ Sémiologie du système nerveux (in *Traité de Médecine de Bouchard Brissaud*), 1900.

¹⁰ Le syndrome thalamique, Thèse de Paris, 1907.

hemiataxia and astereognosis of the cerebral type, and usually by very painful subjective sensations, particularly in the shoulder-joint. The preponderance is upon the sense of attitudes, the condition is nearly always preceded by fugitive hemiplegia, and is often followed by a posthemiplegic choreoathetosis.

When cranial nerve symptoms are added to the foregoing, it can safely be said that the lesion is in the mid-brain or pons; in the latter it causes trembling, cerebellar asynergia, dysarthria, and palsy of associated lateral movements of the eyes with nystagmus on looking up or down. A hemianesthesia of subcortical origin requires a lesion so vast as to involve the motor projection fibers, and is therefore accompanied by a marked hemiplegia. But when cortical, an anesthesia is never completely segmental and is more conspicuous distally, especially with regard to localization and stereogenesis, as Bonhoffer¹¹ insists. He believes paresthesia originates in projection fibers.

Kütner¹² has demonstrated that mono-anesthesia is always cortical unless residual. Déjérine, however, believes it impossible to differentiate between cortical, subcortical, and capsular anesthesia unless in the case of the thalamic syndrome already cited. Kütner believes the pressure and vibration senses are the least affected. Friedrich Müller¹³ agrees that it is the sense of attitudes and stereognosis which manifest the greatest disability, and that the further from the cortex, the more stable is the disturbance and the more are attacked the senses of pain, touch, and temperature.

An interesting case is that of Liepmann,¹⁴ in which there was no loss of cutaneous sensibility, but much diminution of the deep sense in a case operated upon for infantile hemiplegia.

The hysterical anesthetics are characterized by being completely removable by suggestion, and susceptible of returning under the same influence at the will of the operator (Babinski¹⁵ Williams¹⁶).

The history of their onset is generally traceable to imitation or perhaps even more often to unguarded medical examination, as in the case in which the doctor gleefully related, "The boy had no anesthesia at first, but I examined him most carefully the second time, and found the foot anesthetic; on the third occasion the leg became so, and the defect then extended up the whole limb." The stigmata are valuable corroboratively, but only as proof of suggestibility, beyond which they have no validity. The pupillary reaction to pain occurs in organic cases as well as functional cases, unless that particular afferent path is interrupted.

The fact that the anesthesia is most marked in the most paralyzed limb affords no real help to diagnosis; for this is apt to be the case

¹¹ Deut. Ztsch. f. Nervenhe., 1904, xxvi, 5 to 7.

¹² Monats. f. Psy. und Neur., 1905, xvii, 312.

¹³ Sammlung klin. Vort., 1905, Nos. 394 and 395, series xiv.

¹⁴ Neurol. Zentralbl., 1904, p. 740.

¹⁵ Conférence devant l'Internat., 1906, "Ma Conception de l'Hystérie."

¹⁶ International Clinics, September, 1908.

by suggestion as well as by morphological contiguity. Nor is variability so safe a criterion as generally postulated; for Egger's¹⁷ researches have shown how variable modifications of sensibility often are even when due to organic changes. The fugitive character of pain when present is, however, in favor of hysteria, speaking generally, as is the invariableness of the kind of esthetic perturbation; this is contrary to teaching in text-books, which are also erroneous in stating that distribution of disturbed sensation in spots is probably hysterical (Déjérine),¹⁸ for, as a matter of fact, such anomaly is very common in tabes and other radicular affections, and occurs also in multiple and mixed sclerosis of the cord. Involvement of all the special senses is hardly possible from purely organic causes, although the commonness of organic "point d'appui" for any hysterical clinical picture should prevent us from denying any organic element, even when hysterical factors bulk largely in the case.

As regards unilateral deafness, an organic lesion may be excluded by Gellé's test of consensual synergic response upon politzerization of the affected side.

Cord Lesions. The Brown-Séquard syndrome is characterized by complete dissociation of sense of attitudes from deep pain, as Head¹⁹ has proved, as well as the well-known crossed loss of temperature and pain sense. The disputes regarding the loss of tactile sensibility were due, as Head has shown, to the faulty methods then employed; for a touch by the finger of the observer stimulates not only tactile but deep sensibility.

In some of these cases there is further dissociation between tactile discrimination (ascertained by Weber's circle) and tactile localization. The loss of the former is always accompanied, when due to a cord lesion, by loss of sense of passive position. Moreover, tactile localization is never impaired unless the sensitivity to touch is also diminished.

The syndrome of syringomyelia is another dissociated one, again made possible by the intramedullary regrouping of sensory impulses, for the interruption is almost confined to the heterolateral temperature and pain paths, all of which run to Gowers' tract. All forms of pain are equally involved, deep, epicritic, and protopathic, and neither protopathic nor epicritic appreciation of temperature is possible. In the exceptional cases of gliosis confined to the posterior horn no syringomyelic dissociation is present, for in this situation the sensory impulses are not yet regrouped, and hence are all involved.

The lesion of multiple sclerosis does not, as a rule, entirely interrupt the conductivity of axones, but it interferes with the equable

¹⁷ Rev. neurol., 1904.

¹⁸ Pathogenesis of Tabes Dorsalis, AMER. JOUR. MED. SCI., August, 1908.

¹⁹ Brain, 1906.

flow, and leads to rapid fatigue, as demonstrated by the tuning-fork, for which the duration of perception diminishes often over 50 per cent. (Egger²⁰). The functional disability derived from this defect is practically nil, except as regards tonus regulating impulses, the marked interference with which is shown by the intentional tremor (of which nystagmus is part) and the incoördination.

Radicular Anesthesias. A type of esthetic perturbation very important from a diagnostic point of view is the radicular, found conspicuously in the symptomatic sciaticas, and enabling one to localize, and often, by so doing, to infer, the nature of the pathological process at work (Lortad-Jacob,²¹ Déjèrine,²² Carnus²³). The radiculitis of tuberculous or syphilitic pachymeningitis is of this kind. The diagnosis of these conditions from the symptomatic sciatic of spondylitis or other arthritic lesion is made by the sensory loss being so clearly radicular. Of course, one must exclude referred pains of visceral inflammation and of joint conditions, themselves, by the use of Lesègue's sign and the watching of the opposite leg, which is drawn up too when a true sciatic irritation is produced.

In the upper extremity band anesthesias are very common, and again signify a radicular affection. Through the embryonic twisting not being so great as in the lower extremity, nerve trunk involvements are less readily distinguished from those of the roots. Acroparesthesia of only a few fingers should lead to a careful investigation of objective changes in the sensibility (Morrison Davis²⁴). They may be due to angina pectoris, supernumerary rib, tabes, spondylitis, tuberculous pachymeningitis, etc.

In the trunk, the residual pains of an old zona must be excluded before being referred to some affection of a deep-seated organ or bone growth. A band hypoesthesia will often clinch the diagnosis of such cases.

In the neck and face also an esthetic modification of radicular distribution often enables a distinction to be made between simple neuralgia and involvement of nerve roots. For instance, a marked pharyngeal hypoesthesia may occur in the course of spondylitis or Pott's disease. Most helpful in diagnosis are, first, the algesia when the spinal accessory is involved by a diseased lateral sinus; second, the anesthesia of the tympanic membrane and external meatus occurring during certain otalgias, and enabling us to refer many of these hitherto obscure cases to their origin in a herpetic inflammation of the geniculate ganglion, thus saving us much unnecessary meddling with the tympanum (Ramsay Hunt²⁵); and third, the pain and anesthesia in the distribution of the ophthalmic division of the fifth nerve when the carotid artery is aneurysmal or the cavernous sinus diseased.

²⁰ Rev. neurol., 1906.

²² Loc. cit.

²⁴ Rev. neur. and psych., 1907.

²⁵ Jour. Nerv. and Ment. Disease, February, 1907.

²¹ Rev. de med., 1905, xxv, 817.

²³ Les radiculitis, Paris, 1908.

CYSTS OF THE COMMON BILE DUCT.

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THE following case was, clinically and pathologically, of unusual interest: P. R., a school girl, aged eight years, was sent to the University Hospital on account of persistent jaundice and an abdominal tumor. She was admitted to the service of Dr. Charles H. Frazier, to whom I am indebted for permission to use the clinical data. The following notes are abstracted from the patient's history on admission to the hospital:

Family History. Father and mother are both in good health. Three other children are living and well. One child died of cholera infantum. Father had a sore on his penis sixteen years ago. His physician cauterized it and gave him medicine during the ensuing year. There were no subsequent manifestations, and he has been well ever since. Mother had one miscarriage, about four months ago. The patient's maternal grandfather and paternal grandmother died of carcinoma of the stomach.

Social and Previous Medical History. The patient has been going to school for the past three years, and until about one year ago was always bright, strong, and active. She has had none of the acute infections of childhood, and has always been considered a healthy child.

History of Present Illness. About a year ago the patient began to be jaundiced. This jaundice was unaccompanied by pain or other manifestations of illness, except for occasional attacks of nausea. The jaundice has been persistent and has gradually progressed in severity. With the increase in the jaundice the patient's appetite has deteriorated, and there has been a moderate loss in weight. For the past eight months the stools have been clay-colored and the skin itchy. Three weeks ago the mother noted a large mass in the middle and right upper quadrants of the abdomen. The mother is sure that she would have noticed it had it been present before then. She can give no information as to any increase in size since it was first noticed. The child complains of no pain or other discomfort, and sleeps well. There are no symptoms referable to the cardiovascular, nervous, respiratory, or genito-urinary systems.

Physical Examination. The patient is a well-formed, rather poorly nourished girl of normal size for her years. She has a bright, intelligent expression. The skin of the entire body, the visible mucous membranes, and the conjunctivæ have an intense, bright icteric hue. There are no superficial glandular enlargements.

The pupils are equal and react promptly to light and accommodation. The tongue is clean and moist, and the teeth are in good condition. The examination of the heart and lungs reveals no abnormalities. The upper border of liver dulness commences at the upper border of the fourth rib in the right midclavicular line. The sharp edge of the liver can be distinctly palpated about one-half inch below the costal margin. Commencing immediately below the edge of the liver is a protuberant mass extending from the right midaxillary line to one and one-half inches below and one and one-half inches to the left of the umbilicus. It is flat to percussion, is



FIG. 1.—Showing the margin of the ribs and the boundaries of the tumor.

not tender, and moves downward with inspiration. It gives the impression of being cystic. There is tympany to the right, below, and to the left of the mass. Inflation of the colon shows that organ to be situated below the mass. The palpating finger is easily inserted between the tumor and the edge of the liver. Pressure has exerted such influence on the lower right portion of the thorax as to produce marked shortening and elevation of the margin of the ribs on that side. This can be seen in the accompanying photograph (Fig. 1), in which the margin of the ribs and the boundaries of the tumor have been outlined. The spleen is not palpable and no alteration in the size or position of the kidneys can be determined.

Urinalysis. Deep amber; light flocculent precipitate; acid; specific gravity, 1030; albumin and sugar negative; bile pigments positive.

Blood. Hemoglobin, 79 per cent.; erythrocytes, 4,190,000; leukocytes, 11,870. Differential count: Polymorphonuclear neutrophils, 60 per cent.; lymphocytes, 23 per cent.; large mononuclear leukocytes, 15 per cent., transitional cells, 2 per cent.

Feces. Clay-colored; solid; faintly acid; normal odor; small number of leukocytes and epithelial cells; moderate amount of casein; occult blood negative; faint trace of urobilin.

Two days after admission to the hospital the patient was operated on by Dr. Frazier. When the mass was exposed it was found to be a cyst about the size of an ostrich egg. Coursing over its ventral surface was the stretched and flattened duodenum. The cecum and appendix were adherent to the lower pole of the cyst. The first impression was that the tumor was a cyst of the gall-bladder, but on further exploration the slightly distended gall-bladder was found lying between the cyst and the lower surface of the liver. A cannula was introduced into the cyst and about a quart of fluid resembling bile drawn off. It was then thought that the condition might be a cyst of the common duct—a view that was soon confirmed by further exploration. The adhesions were freed, the pedicle tied, and the sac removed. A dressed tube was fastened in the gall-bladder and a Mikulicz drain inserted into the wound alongside of it. In spite of vigorous stimulation, the patient failed to rally after the operation, and died three days later.

Autopsy. The autopsy, limited to the parts involved in the operation, confirmed the fact that the tumor was a cyst of the common duct. It measured 15 x 8 x 7 cm. (Fig. 2). The wall averaged about 2 mm. in thickness. The internal surface presented a peculiarly mottled appearance, by reason of the distribution of smaller and larger, irregularly shaped, brownish-green areas on a yellowish-white background. Microscopically the wall was seen to be composed of dense fibrous tissue, with an external peritoneal covering. The dark areas on the inner surface showed themselves to be more richly vascularized than the surrounding areas, and to contain deposits of bile pigments. The gall-bladder was slightly dilated; it was prevented from participating in the dilatation of the common duct by the partial obliteration of the cystic duct, resulting from compression by the cyst. The hepatic ducts were also slightly dilated. The portion of the common duct between the cyst and the duodenal papil presented itself as a firm cord-like structure, the size of a goose quill in diameter. The extramural portion measured 1 cm. in length, and was patulous; the intramural portion, which measured 2 cm. in length, was entirely devoid of a lumen. Microscopic examination of the latter portion revealed extensive fibrosis, with complete obliteration of the lumen and disappearance of all

traces of epithelial elements. No opening could be found from the duodenal papilla into either the common bile duct or the duct of Wirsung, and as far as could be determined the latter suffered the same obliteration as the duodenal portion of the common duct. This view was substantiated by the histological examination of the pancreas, which showed advanced chronic perilobular pancreatitis. The liver was large, hard, and of a dark-green color. The surface was coarsely granular. Microscopically, changes characteristic of a biliary cirrhosis were seen: marked perilobular fibrosis, moderate intralobular fibrosis, dilatation of some of the intrahepatic bile ducts, and great proliferation of bile canaliculi.



FIG. 2.—Photograph of the cyst (two-thirds natural size). *A-B*, the opening of the cystic and hepatic ducts into the cyst; *B-C*, the left wall of the common duct, forming the left wall of the cyst; *C*, the peripheral end of the common duct.

I have collected twenty-eight cases of retention cysts of the common bile duct from the literature. Some of the reports are so meagre as to make them of interest only in so far as to put the case concerned on record. Others are more elaborate, and, with the case herein reported, permit the compilation of some interesting data bearing upon the condition.

Of the 19 instances in which the sex is mentioned, 17 occurred in females. Such a preponderance of one sex is indeed striking; and yet an analysis of the cases throws no light upon the significance of this relative frequency of the condition in females. The features which tend toward the greater frequency of other diseases of the

biliary passages, especially gallstones, in females are certainly not concerned in the production of cysts of the bile ducts, for these features are, for the most part, dependent upon modes of dress or functions peculiar to the female sex, possible only in adult life; and the majority of cases of cysts have occurred in the young. Of the 22 cases in which the age was mentioned, the average was fifteen years and eight months; 2 were under one year of age; 7 were between one and ten years of age; 6 between ten and twenty years of age; 4 between twenty and thirty; 1 between thirty and forty; and 2 between forty and fifty years.

Turning our attention to the anatomical peculiarities presented by the cases that have been studied, especially in regard to the lower end of the common duct and any condition there existing to cause obstruction, we find that of the 19 cases in which the result of this examination was mentioned, gallstones were found in 3, a papilloma in 1, myomyxomatous polyps in 1, scirrhus pancreatitis in 2, catarrhal cholangitis in 1, a simple stenosis or obliteration of the peripheral end of the lumen in 6, and a valve-like fold or angular insertion of the duodenal end of the duct in 5 cases. In addition, 2 of the cases in which the peripheral end of the duct was obliterated showed also this angular insertion. This great variety in the apparent cause of the obstruction and subsequent dilatation at once suggests that there is no unity of the pathogenesis of cysts of the bile ducts, but that any obstruction of the lower end of the duct may lead to cyst formation. However, let us conduct a further analysis. Of the 4 cases over twenty-one years of age in which the cause of the obstruction was mentioned, gallstones were found in 2, a papilloma in 1, and a valve-like fold in 1. Whereas, in the 13 cases under twenty-one years of age, a simple obliteration of the lumen was found in 6 instances, a valve-like fold in 4, catarrhal cholangitis in 1, and scirrhus pancreatitis in 2. I doubt the value of the opinion that scirrhus pancreatitis was the cause of the obstruction in the 2 cases so reported. They were both observed many years ago—one in 1723, the other in 1817. Considering the degree of firmness presented by the normal pancreas to palpation, and realizing the infrequency of scirrhus pancreatitis in childhood, I am loath to accept this diagnosis unsupported by a histological examination.

In considering the cases in which an obliteration of the lower end of the duct was found, we can but conjecture what the cause of this obliteration may have been. The fact that practically all these cases occurred in early life might suggest that a congenital atresia of the bile ducts was at the basis of the condition, but this is extremely improbable, for the vast majority of infants suffering with congenital atresia of the bile ducts die before the eighth month of life.¹ The fact that the case reported by Rolleston showed many manifestations of congenital syphilis, and the probable history of

¹ Lavenson, Jour. Med. Research, 1908, civ, 61.

syphilis in the father of the patient whose case I am reporting, naturally direct attention to the possibility of the obliteration being the result of a syphilitic fibrosis. However, in the other cases there is not sufficient basis for entertaining this opinion; and it must be considered as but a vague possibility. Another possibility is that the obliteration was the result of the organization consequent upon a catarrhal cholangitis. This hypothesis seems plausible in my own case, at least, by reason of the fact that symptoms of catarrhal cholangitis preceded for some time the development of the tumor; though, of course, it must be admitted that the latter may have been present a considerable period before it was recognized by the parents. Why the duct should undergo such extensive dilatation in the presence of an obstruction in early life, as compared with the infrequency of the same occurrence in the obstructions of later life, is difficult to explain. Probably the force with which the bile is excreted is not much less in early life than in adult life, but the more delicate walls of the bile ducts of the young are less able to withstand the strain of increased internal pressure. There must, however, be some element in addition to this; otherwise it would be rational to expect to find cysts in at least some of the cases of congenital obliteration of the bile ducts in which the obstruction is in the lower end of the duct; I am not aware of any such case having been reported. The other element in the production of the cysts is, in all probability, a congenital weakness of the muscular tissue of the wall of the duct.

In the cases of Douglas, Arnolds, Fenger, Arnison, Rostowzew, and Konitzky, and in my case, the lower end of the duct, or its fibrous remains, was found to enter the cyst at so acute an angle as to produce a valve-like formation at the duodenal end of the cyst. Rostowzew looks upon this angular insertion of the duct as the cause of the obstruction and the subsequent dilatation. His view can be best appreciated by glancing at the accompanying diagrams. As is shown in Fig. 3, the intramural portion of the common duct runs normally from left to right; in other words, in the same direction as the portion of the duct above the duodenum, but at a somewhat more acute angle. Rostowzew believes that in some cases the intramural portion of the duct, instead of running from left to right, runs from right to left, as is shown in Fig. 4. This according to his view produces a kink, which results in obstruction to the outflow of bile and subsequent cyst formation, as is shown in Fig. 5. I believe Rostowzew's hypothesis to be incorrect. In my opinion the angular insertion of the duct is the result of the cyst formation, and not its cause. If one recalls the anatomical relations of the common bile duct as it runs in the gastrohepatic omentum, it will be appreciated that lying farthest to the right as it does, any tendency to dilatation that it may assume toward the left would have to overcome the resistance offered by the hepatic artery and the portal vein; whereas, to the right no structures are interposed to restrict its dilatation.

In my case, in which, in addition to obliteration of the duodenal end of the duct, this angular insertion was found, it can be seen by glancing at the accompanying photograph of the cyst (Fig. 2) that the dilatation was entirely to the right. The short straight line *B-C* represents the left wall of the common duct, the right wall alone being distended to form the cyst. With such extensive dilatation to the right, the peripheral undilated portion of the duct is compelled to change its direction, and instead of running from left to right, as it normally does, to run sharply from right to left, as is shown in Fig. 6.



FIG. 3



FIG. 4

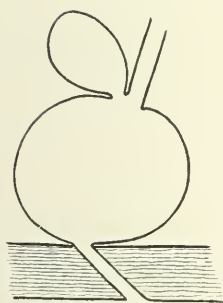


FIG. 5

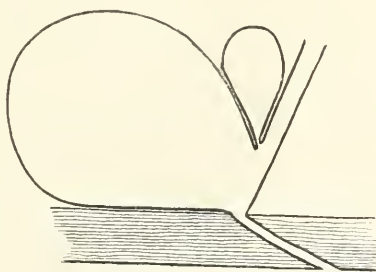


FIG. 6

FIGS. 3, 4, 5, and 6.—The varying modes of insertion of the common bile duct into the duodenum.

This view is substantiated by the fact that in 3 of the 7 cases in which this angular insertion was present, obliteration or obstruction of the peripheral portion of the lumen was also found. In the other 4 cases it is not specifically mentioned whether or not the peripheral portion of the duct was patulous. Assuming that it was patulous, I believe it probable that in the presence of a congenital weakness of the muscular tissues of the duct wall a temporary obstruction, as by a catarrhal cholangitis or a mucous plug, could offer sufficient resistance to the outflow of bile to result in dilatation and a consequent

angular insertion of the lower end of the duct. Even though the cause of the obstruction should subsequently subside, by the time the cyst is formed the valve-like opening could undoubtedly act as a secondary cause of obstruction.

SYMPTOMATOLOGY. There is little to be said of the symptomatology of the condition, aside from what has already been mentioned in discussing its pathology and pathogenesis. It should be recalled that in many of the cases symptoms of biliary obstruction have preceded the formation of a cyst, or, probably better, the recognition of a cyst, by a considerable period of time. Recognition must also be taken of the fact that it occurs relatively much more frequently in childhood and in the female sex. The conditions with which it is most likely to be confused are cysts of the pancreas and dilatation of the gall-bladder. Probably, in the vast majority of cases, only an exploratory incision will determine the diagnosis.

TREATMENT. It can be readily appreciated that surgery offers the only possibility of cure. Of the 21 cases in which more or less extensive surgical procedures were adopted, simple puncture of the cyst was performed in 3 cases, all of which resulted in death. Incision and drainage was performed in 14 cases, with 13 deaths. Cholecystenterostomy was performed in 4 cases, with 3 recoveries. The latter operation thus seems to offer the best chances of cure.

The following are the references to the 28 cases collected from the literature:

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SOME CASES OF MULTIPLE INFECTION.

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ALTHOUGH the subject of multiple infection has always commanded attention, it has recently gained added interest, owing to the use of bacterial vaccines in the treatment of many infectious diseases. The following cases show that these methods must at times be directed toward the destruction of several varieties of bacteria in order to accomplish any results, and they are, for the most part, examples of the entrance of bacteria through perforations of the gastro-intestinal tract.

There is quite an extensive bacterial flora present in the intestinal tract. Ford¹ has made a very exhaustive study of this subject, and has isolated a large number of pathogenic bacteria from the intestine. In addition to various saprophytic organisms, Ford and others have found that the intestine contains such bacteria as *Bacillus coli*, *Bacillus aërogenes*, *Bacillus Friedländeri*, *Bacillus enteritidis*, *Bacillus paratyphi*, *Bacillus dysenteriae* (these types do not agglutinate with dysenteric serum), *Bacillus pyocyaneus*, *Staphylococcus albus*, *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Bacillus aërogenes capsulatus* (Welch).

CASE I.—The first case of multiple infection which we wish to report occurred as an extensive fibrinopurulent peritonitis following the perforation of a typhoid ulcer. The history of the case is as follows: About four and one-half months before his death the patient complained of cough, dyspnoea, a sense of oppression in the chest, and occasional attacks of suffocation. He gave a history of slight indulgence in alcohol, but no venereal history. About two and one-half months before his death he entered the hospital. The signs of an aneurysm of the arch of the aorta were detected, and the patient remained up and about the wards of the hospital until four days before his death. On February 4 his temperature rose to 104° and he was ordered to bed. The next day his temperature was normal and he was allowed to sit up and walk about the ward. On February 7 and 8 he remained in bed, and a slight distention of the abdomen was noticed. He died on the night of February 8.

The aorta showed a general dilatation beginning just above the valves and ending at the origin of the great vessels. The dilatation

¹ Studies from the Royal Victoria Hospital, Montreal, i, No. 5.

was uniform, and not saccular or fusiform. The intima of the aorta showed marked endarteritis and atheroma. The aorta measured 10.5 cm. in diameter. The abdominal cavity contained about 1 liter of purulent fluid, and the peritoneal surface of the intestines and liver was covered with a fibrinopurulent exudation. A small perforation of the small intestine was found about 30 cm. above the cecum, and on opening the intestine a smooth-walled ulcer was detected. Numerous other ulcers indicating the third week of the typhoid fever were found. The patient had gone through almost a complete attack of typhoid fever, ending in perforation and extensive fibrinopurulent peritonitis, without any fever or any of these conditions being even suspected.

The point of main interest in this case, however, is the extensive multiple infection of the peritoneal cavity, and the number of different bacteria present shows how many different species can take part in an infection when the contents of the intestine are emptied into the peritoneal cavity.

Bacteriological Examination. Cultures were made from the pus from the peritoneal cavity and from the blood of the heart and spleen on the Drigalski-Conradi medium in Petri dishes, and numerous colonies of the typhoid bacillus and the colon bacillus developed from the cultures from the spleen and blood. No typical typhoid colonies were grown from the cultures from the peritoneal cavity, but four other distinct varieties of bacteria were obtained. These were *Streptococcus pyogenes*, *Diplococcus pneumoniae*, *Bacillus aerogenes capsulatus*, and *Bacillus coli*. *Streptococcus pyogenes* was typical in morphology and cultural characteristics, and *Diplococcus pneumoniae* showed capsules stained by Hiss' method, and was virulent for white mice. *Bacillus aerogenes capsulatus* produced the typical reaction in milk and its capsule stained by Welch's method. It was positive to Gram's stain and produced the foamy organs from hydrogen gas when injected into rabbits, who were immediately killed and exposed to 86° F. for fifteen hours. Control rabbits were negative. *Bacillus coli* was typical and produced gas in glucose, lactose, and saccharose.

The presence and location of these various bacteria were studied in stained specimens of the typhoid ulcers and the fibrinopurulent exudate on the peritoneal surface of the intestine. The necrotic material at the base of the ulcer contained numerous large Gram-staining bacilli which were almost certainly gas bacilli. These were mingled with other smaller bacilli with rounded ends which were colon bacilli. Numerous chains of streptococci were also found in these necrotic areas and diplococci were also present. Many of these latter closely resembled the pneumococcus, but it is impossible to distinguish absolutely between these and streptococci. Cover-slips stained at autopsy from the peritoneal exudate showed all four of these types mentioned above, but stained sections of the

intestine showed only three types of organisms in the mesh-work of the fibrinopurulent exudate on the peritoneum. The large Gram-staining gas bacilli were arranged in large round masses, but the streptococci and diplococci were scattered through the exudate. No colon bacilli could be noted in this exudation, and most of these latter organisms must have been free in the general peritoneal cavity. While all of these organisms must have been present in the intestinal contents, yet they first exerted their pathogenic effects upon the necrotic base of the typhoid ulcers. The rupture of one of these ulcers must have introduced many of these organisms in a virulent condition directly into the peritoneal cavity, where they produced a very extensive fibrinopurulent peritonitis.

This case, therefore, showed the presence of five organisms in the body, four in the pus from the peritoneal cavity and one (*Bacillus typhi*) in the blood.

Another patient with typhoid fever entered the city hospital several years ago and died after a prolonged and severe illness. Numerous ragged, necrotic ulcers were found at the autopsy, and small scattered abscesses were found in the kidneys. Cultures from the blood, liver, and spleen showed the presence of many colonies of *Bacillus typhi*, *Bacillus coli*, *Bacillus pyocyaneus*, and *Streptococcus pyogenes*, and cultures from the abscesses of the kidney gave *Staphylococcus aureus*.

Finney² records the results of a bacteriological examination of the peritoneal exudate in five cases of intestinal perforation of a typhoid ulcer. In one a pure culture of *Bacillus coli* was found, in one *Streptococcus pyogenes*, in one *Staphylococcus aureus* and *Bacillus coli*, and in one *Bacillus coli* and an unknown micrococcus were obtained. In one case the cultures were sterile. Cushing³ also reports a case of a typhoid perforation at the end of the fourth week. There was diffuse purulent peritonitis, and cultures made at the autopsy from the pus gave *Streptococcus pyogenes* in pure culture.

Flexner⁴ also describes several cases of polyinfection in typhoid fever. The first case was that of a woman, aged thirty years, who aborted several days before death. The typhoid bacillus was found in the placenta, spleen, liver, and kidneys, the colon bacillus in the kidney and heart's blood, and *Bacillus proteus* in the bile. In the second case death occurred in the sixth week. Healing ulcers were found, together with an abscess of the prostate gland, bronchopneumonia, and serofibrinous pleurisy. The typhoid bacillus was isolated from the blood, liver, bile, kidneys, and mesenteric glands, while *Streptococcus pyogenes* was found in the lungs, pleural cavity, heart, and larynx. The larynx also contained *Bacillus pyocyaneus*, and

² Johns Hopkins Hospital Reports, 1900, viii, 160.

³ *Ibid.*, p. 224.

⁴ *Ibid.*, p. 259.

the abscess in the prostate gland gave *Proteus vulgaris*. In a boy, aged nineteen years, with perforative peritonitis, the typhoid bacillus and *Streptococcus pyogenes* were cultivated from the pus.

Flexner,⁵ in an earlier article, also reported several interesting cases of multiple infection in typhoid fever. In the first case there was a general typhoid bacteremia, and the autopsy showed multiple abscesses in the kidney and purulent infiltration of the parotid gland. Cultures from the heart's blood and the kidney showed nothing but typhoid bacilli, while the parotid gland gave pure streptococci, and the lung streptococci, typhoid bacilli, and *Bacillus coli*. In a second case, a general infection with typhoid and perforative peritonitis, *Bacillus typhosus* was isolated from the heart, bile, and other viscera, while the streptococcus alone was found in the purulent exudate in the peritoneal cavity. In one other similar case the peritoneal cavity contained the typhoid bacillus, the colon bacillus, *Proteus vulgaris*, *Streptococcus pyogenes*, and *Staphylococcus aureus*; while another case of perforative peritonitis showed the streptococcus and colon bacillus.

CASE II.—We have also observed an interesting case of multiple infection in a steer, which was first noticed in one of the large abattoirs after the heart and lungs had been removed from the carcass. Fig. 1 shows the heart muscle containing a needle. The description of the gross specimen is as follows: Practically the entire visceral surface of the pericardium covering both auricles and ventricles is covered with a thick, dirty, grayish-yellow, fibrinous membrane which is either shaggy or coarsely corrugated. This is firmly adherent, and when stripped off leaves a rather pale, light brown, opaque, cardiac muscle beneath. The parietal pericardium is either red and injected or is covered with a thick fibrinous membrane. Midway between the apex of the left ventricle and the auriculoventricular septum there is a round, dark red, hemorrhagic area about the size of a fifty cent piece. This contains an irregular perforation, in the centre of which a rusty needle, embedded by its point, can be seen. The needle has not completely penetrated the wall of the left ventricle. The needle was firmly embedded in the muscular surface of the left ventricle, but could work to and fro quite loosely in the tear of the stomach wall. This irregular tear in the stomach might, therefore, be explained by the movement of the heart upon its axis. The needle firmly embedded in the heart must have moved to and fro at its periphery with a motion somewhat similar to that of a pendulum. In this way it gradually produced the irregular tear in the stomach, although it was swallowed and penetrated the stomach wall first, and later the heart muscle.

Sections were made from the wall of the left ventricle, which was covered by the thick, fibrinous membrane, and the following condi-

⁵ Johns Hopkins Hospital Reports, 1895, v, 243.

tions were noted: The heart muscle itself is normal, but the pericardial surface is covered with a rather thick layer of organizing fibrous tissue. This fibrous tissue contains a few newly formed bloodvessels and is richly infiltrated with fibroblasts of various shapes and sizes. A moderate number of polymorphonuclear leukocytes are also present. Attached to the outer surface of this is a thick layer of very coarse fibrin, which also shows signs of beginning fibrous organization; newly formed bloodvessels and fibroblasts can be seen entering it at its attachment to the fibrous pericardium, and layers of endothelial cells covering the pericardium can be seen proliferating and heaping themselves up into layers of several cells in thickness. There are groups of fibroblasts scattered through this organizing fibrin.



FIG. 1.—Showing a needle in the muscular wall of the heart, surrounded by a hemorrhagic area, and showing also thick masses of fibrin.

Sections were also made of the œdematous mediastinal tissue adjacent to the pericardium. This consists of much œdematous fibrous tissue, which is diffusely infiltrated with polymorphonuclear leukocytes. These are often in large groups, forming small miliary abscesses.

Sections from the stomach showed, just adjacent to the perforation by the needle, that the mucous membrane and submucous coat are entirely replaced by a thick surface layer of fibrin and deeper layer of coagulation necrosis. The superficial layer con-

tains large, irregular groups of bacteria; there are also scattered groups of polymorphonuclear leukocytes, and many fibroblasts can be seen entering the inflammatory layer at its junction to the muscular wall of the stomach. Some of these cells are large and round, their cytoplasm stains with eosin, and they resemble lymphocytes. A lymph gland adjacent to the stomach shows great enlargement of the lymph sinuses, and these sinuses contain many polymorphonuclear leukocytes and large and small lymphocytes. The germinal centres in many of the lymph follicles are well shown, but no bacteria are present.

The abscesses in the liver show central areas of complete necrosis. These areas are surrounded by polymorphonuclear leukocytes and the abscess is enclosed by a thick connective-tissue capsule containing numerous fibroblasts and polymorphonuclear leukocytes. The capsule of the abscess also contains small scattered abscesses.

Cultures were made from the fibrinous exudate on the pericardium and from the abscess of the liver. Three distinct species of bacteria were obtained in each instance. These were *Bacillus coli*, *Bacillus aërogenes capsulatus*, and the pneumococcus. *Bacillus coli* fermented about 40 per cent. in glucose, lactose, and saccharose, and its cultural characteristics were typical. *Bacillus aërogenes capsulatus* stained by Gram's method shows well-stained capsules and produced the typical "Schaumorgane," or foamy organs, when injected into the ear vein of a rabbit. The pneumococcus showed a capsule, coagulated and acidulated milk, and produced the death of a rabbit in forty-eight hours. At the autopsy on the rabbit the lungs were covered by a fibrinous exudate and the right lung was consolidated and sank in water. On microscopic examination the lung contained large groups of cells which seemed to be necrotic epithelial cells; other areas contained an exudate of polymorphonuclear leukocytes or showed intense congestion. On staining by Weigert's method the air vesicles contained pneumococci, and these organisms were also obtained from the lung by cultures. The liver showed fatty degeneration and the capillaries contained hyaline thrombi apparently due to agglutinating red corpuscles. The pneumococcus was recovered by cultures from the blood of the heart and liver.

CASE III.—A case of puerperal infection with *Bacillus aërogenes capsulatus* and *Streptococcus pyogenes*, which entered the obstetrical ward of the hospital, was also of some interest from several standpoints.

The patient had a normal child in 1901, and in 1902 was treated for retroversion of the uterus. In 1905 the patient went into labor, and as the position of the child was transverse it remained undelivered for four days, although podalic version was attempted. At the end of four days the patient was admitted to the City Hospital with a temperature of 102° , and rapid and faint pulse and respira-

tions. She grew rapidly weaker and died several hours after admission.

An autopsy was performed and the fundus of the uterus was only 7 cm. below the tip of the ensiform cartilage. The peritoneal surface was covered with a fibrinopurulent exudate and the broad ligament and the pelvic fascia were distended by a dark-red fluid containing many gas-bubbles. The anterior and lateral walls of the vagina and bladder were ruptured. The body of the child had escaped into the vagina, but the head was still in the uterus, the retention of the head being caused by its greatly increased size. The frontal and parietal bones were separated by an interval of 3 cm., and there was an interval of 11 cm. between the parietal and occipital bones. The parietal bones were separated from each other by an interval of 10 cm. On opening the abdomen of the child gas escaped which burned with a blue flame, and the liver contained many gas blebs. Fig. 2 is a reproduction of a photograph of the fetus.

On bacteriological examination *Streptococcus pyogenes* was found in the liver of the mother and in the fibrinopurulent exudate. *Staphylococcus aureus* and *Bacillus coli* were also found in a hemorrhagic area on the transverse colon. *Bacillus aërogenes capsulatus* or the gas bacillus was not found in the peritoneal cavity, the liver, or the kidney of the mother. The uterine cavity remained sterile, but *Bacillus aërogenes capsulatus* was found in the placenta, in the uterine wall, and in the distended pelvic fascia and the broad ligament. The brain, liver, kidney, and blood of the child all contained gas bacilli, and on staining these tissues they were found to be present in large numbers. The placenta at its uterine attachment showed a thick layer of decomposing material containing gas bacilli, and they were also found in the maternal blood spaces and necrotic villi. They had not invaded the tissues of the uterus to any extent, and as the autopsy was performed within two hours after death it is interesting to note that *Bacillus aërogenes capsulatus* invaded only dead or decomposing tissue. The body of the dead child and the decomposing placenta contained many gas bacilli, but these did not penetrate the uterus of the living mother and invade the peritoneal cavity, as did *Bacillus coli*, *Streptococcus pyogenes*, and *Staphylococcus aureus*.

The case is also interesting from another standpoint, namely, the mechanical obstruction to the delivery of the child, caused by the tremendous distention of the head. The gas infection was limited to the child, while pyogenic bacteria produced an infection of the mother.

Bacillus aërogenes capsulatus, or the gas bacillus, was first observed in puerperal infection by Dobbin,⁶ in 1897. This occurred

⁶ Bull. Johns Hopkins Hospital, 1897, viii, 24.

in a case of physometra, or a gaseous distention of the uterus. Little⁷ states that *Bacillus aërogenes capsulatus* may produce five distinct effects when introduced into the uterus. These are emphysema of the fetus, puerperal endometritis, physometra, emphysema of the uterine wall, and gas sepsis. Cases illustrating all of these conditions are mentioned in Little's article, but we shall only briefly



FIG. 2.—Fœtus with the enlarged and disfigured head caused by gaseous distention.
The arms were torn off in an effort to perform version.

describe his cases of emphysema of the fetus. His first case was that of a Bohemian woman, with contracted pelvis and dystochia. After frequent examinations by a midwife during a labor of four days the patient was admitted to the Johns Hopkins Hospital. The head was found firmly fixed in the superior strait and the uterus

⁷ Bull. Johns Hopkins Hospital, 1905, No. 169, xvi, 136.

was in a state of tetanic contraction, and delivery was only effected after using Tarnier's basiotribe. The gas bacillus was demonstrated in the distended head and tissues of the foetus, and in the placenta. The second case also occurred in a case with contracted pelvis. Several unsuccessful attempts with forceps were made to deliver the child, and after admission to the hospital the head was found to be blocked in the cervix, and the uterus was in a state of tetanic contraction. The head was perforated and the child could then be delivered. Cultures showed the presence of *Bacillus aërogenes capsulatus*. Both of these cases are similar to our own case in having caused obstruction to delivery by gaseous distention of the head of the foetus.

CASE IV.—Another multiple infection of a different kind occurred in connection with a case of mumps. The child was admitted to the City Hospital with swelling of the right parotid gland, and a diagnosis of mumps was made. The fever suddenly became very high, and after several days the patient died. At the autopsy the gland and the surrounding tissues were very much swollen, and the latter contained a seropurulent fluid. The spleen was enlarged.

Cultures from the parotid gland, the blood, liver, kidney, and spleen gave a pure growth of *Streptococcus pyogenes*. The microscopic examination of the various tissues and viscera showed that *Streptococcus pyogenes* was present in large numbers, and that these organisms had produced a number of lesions.

The interalveolar septa of the lungs were greatly thickened, and contained many necrotic areas and groups of polymorphonuclear leukocytes containing many streptococci. Many small bronchi and their surrounding air cells contained masses of streptococci and the capillaries contained emboli of organisms. Some of the pulmonary veins showed fibrinopurulent thrombi with many streptococci. The lymphatic vessels and spaces of the heart and spleen were filled with streptococci and the veins contained infected thrombi. The splenic spaces were filled with groups of necrotic reticular cells and streptococci. An area of necrosis in the pharynx, adjacent to the parotid gland showed a superficial necrotic area containing masses of streptococci which extended into the muscle beneath. The veins contained fibrinous thrombi and streptococci and the lymphatic vessels and perineural and perivascular connective tissue were crowded with these organisms. The entire tissue was densely infiltrated with polymorphonuclear leukocytes and fragmented nuclei. The lymphatic glands in this region contained many areas of necrosis with leukocytes and streptococci, and the connective tissue surrounding the parotid gland was infiltrated with polymorphonuclear leukocytes and lymphocytes, necrotic masses, areas of fibrin, and groups of streptococci. The parotid gland itself did not show any necrosis or cellular infiltration, but the arteries and veins contained fibrinopurulent thrombi and streptococci.

The cytoplasm of many of the cells of the acini contained numerous hematoxylin-staining granules varying in size from 1 to 3 μ m. These granules (Fig. 3) were not derived from the nuclei of the secreting cells. They resemble small protozoa, but we are not prepared to say that they bear any causative relation to mumps.

The lymphatics of the kidney, pancreas, pituitary body, thymus and thyroid glands, and the semilunar and Gasserian ganglion contained emboli of streptococci, and many veins showed fibrinopurulent thrombi and organisms. The presence of streptococci in the veins in some places caused injury to the endothelium, many of

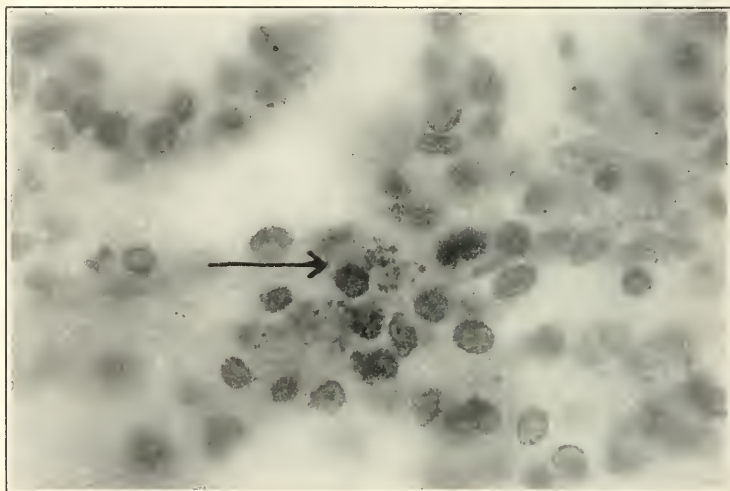


FIG. 3.—An acinus of the parotid gland, showing a number of intracellular bodies in the cytoplasm of an epithelial cell.

these cells having completely disappeared, while others showed marked nuclear fragmentation.

The entire picture is that of an intense bacteremia originating from the parotid gland, and causing purulent, necrotic, fibrinous, and endotheliolytic lesions throughout the entire body.

Another somewhat similar case occurred lately in the City Hospital. A man, aged about thirty years, was admitted with high irregular fever, and great swelling at the angle of the jaw. His body was covered with purpuric spots. He died in about three days. No autopsy was obtained, but a blood culture during life showed numerous colonies of *Streptococcus pyogenes* and *Staphylococcus aureus*.

DIAPHRAGMATIC HERNIA.

By E. T. BELL, M.D.,

ASSISTANT PROFESSOR OF ANATOMY IN THE UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI.

DIAPHRAGMATIC hernia is not a very rare condition. In 1899 Grosser was able to collect 433 reported cases. Considerable attention has been given this subject ever since the work of Leichtenstern¹ appeared. It may seem almost superfluous to add another to the long list of publications on this topic; but the case which I shall describe is an unusual form.

Extensive discussions of the literature may be found in the papers of Lacher,² Thoma,³ and Grosser,⁴ to whose publications the reader is referred. I shall give some of the conclusions to which these discussions lead. Diaphragmatic hernias may be true or false. In true hernias the displaced abdominal organs are invested by a covering of pleura or peritoneum, or both. In the false hernias the serous covering is absent. Grosser's statistics give 40 true and 385 false hernias, 30 of the true hernias being congenital. Diaphragmatic hernias are also classified as congenital, or acquired, although the distinction cannot always be made with certainty. Grosser gives 244 congenital and 181 acquired cases.

Every abdominal organ except the rectum, bladder, and genitals has been found at least once in the thoracic cavity. Usually several organs occur there together. In Lacher's 276 cases the stomach was found in the hernia 161 times; the colon, 145 times; the omentum, 96 times; the small intestine, 83 times; the liver, 45 times; the duodenum, 35 times; the pancreas, 27 times; the cecum, 20 times; the kidney, twice. In 53 of his cases only one organ occurred in the hernia: the stomach alone, 27 times; the colon, 13 times; the small intestine, 6 times; the liver, 6 times; the omentum, twice. The etiology will be discussed latter.

The case observed was that of a negro male, about forty years old, a subject used in the dissecting room. The previous history was not obtainable. Death occurred apparently from a tuberculous pneumonia. The right lung was completely consolidated, and the left contained a number of tuberculous abscesses.

Fig. 1 gives a view of the right side of the thorax. The inferior lobe of the lung has not been removed, and the dotted line *m* indicates the position of the lower border of the base of the lung. It is seen that a small part of the liver *II* projects through the diaphragm. The piece of liver displaced is continuous with the

¹ Zur Diagnose der Hernia diaphragmatica. Berliner klin. Woch., 1874, Nr. 40.

² Ueber Zwerchfellshernien. Deutsch. Archiv f. klin. Med., 1880, xxvii.

³ Vier Fälle von Hernia diaphragmatica. Virchow's Archiv, 1882, lxxxviii.

⁴ Ueber Zwerchfellshernien. Wiener klin. Woch., 1899, s. 655.

main mass of the organ in the abdominal cavity (Fig. 2). It is 8 cm. long and 5 cm. wide, and 2 cm. to 3 cm. high. No part of any other organ is involved in the hernia. It is a false hernia, there

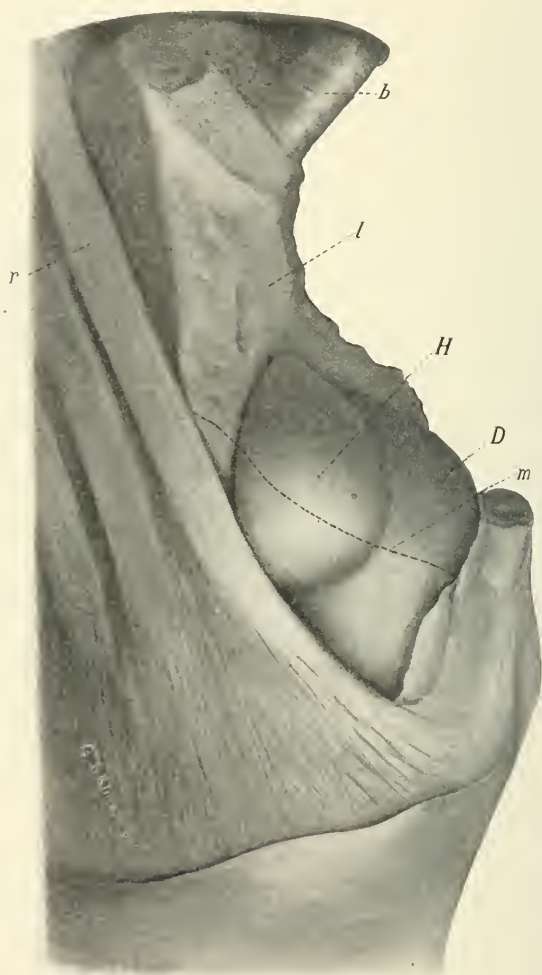


FIG. 1.—Hernia projecting through the diaphragm, viewed from the right side after removal of the superior and middle lobes of the lung ($\times \frac{1}{2}$). *b*, right bronchus; *D*, diaphragm; *H*, portion of liver in the hernia; *l*, inferior lobe of the lung; *M*, broken line representing the lower border of the lung; *r*, 7th rib.

being no pleural or peritoneal sac present. The opening in the diaphragm is elliptical in shape and much smaller than the hernial mass of liver. The opening is 5 cm. long and 2.3 cm. wide, while the displaced mass of liver is 8 cm. long and 5 cm. wide.

The opening is situated in the muscular part of the diaphragm on the edge of the tendinous portion in the angle between the middle and right leaflets of the central tendon. The long axis of the opening coincides with the direction of the muscle fibers. The muscle fibers are apparently torn apart, not ruptured transversely.

The margins of the opening are smooth and fit closely around the neck of the hernia, in part of their extent being adherent to the surface of the liver. The diaphragm is so closely fitted around the neck of the hernia that there could hardly have been any interference with respiration. The edges of the neck of the hernia have been converted into cicatricial tissue *c* from the pressure of the diaphragm.

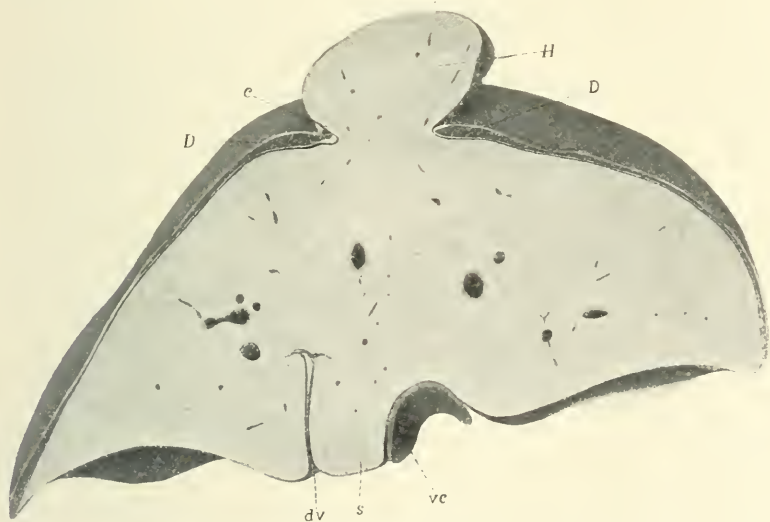


FIG. 2.—Horizontal section through the upper part of the liver passing through the hernial opening ($\times \frac{1}{2}$). *dv*, fissure for the ductus venosus; *c*, cicatricial tissue on the edge of the neck of the hernia; *D*, diaphragm; *H*, mass of liver forming the hernia; *s*, Spigelian lobe; *vc*, vena cava.

ETIOLOGY. Congenital hernias are due to developmental defects in the diaphragm. The formation of the defect occurs some time before the displacement of the abdominal organs. Some of these defects are unquestionably due to incomplete union between the ventral and dorsal anlagen of the diaphragm; for others no satisfactory explanation has been advanced. The size of the opening varies from a 2 cm. opening to complete absence of the diaphragm.

The acquired hernias are traumatic in origin. They are distinguished from the congenital by the following points: (1) All hernias in the newborn in which there is no record of injury during birth are regarded as congenital; (2) most acquired hernias are diagnosticated by a previous history of injury; and (3) in congenital

hernias the edges of the opening are said to be usually much smoother than in the traumatic form. Without a previous history of injury the distinction may sometimes be difficult. Many of the cases given in the literature do not certainly belong to the type to which they are referred.

The usual causes of traumatic hernia are gunshot wounds, saber cuts, severe falls, and heavy blows. The natural openings in the diaphragm are frequently the site of hernia.

Diaphragmatic hernias are about five times as frequent on the left as on the right side. This applies to the congenital as well as to the acquired forms. It is generally believed to be due to the greater protection afforded by the liver on the right side. The traumatic hernias are four or five times as numerous in males as in females, owing to the greater exposure of the males to injury.

In Lacher's statistics two cases are cited in which a small mass of liver alone projected through the right side of the diaphragm. These were then somewhat similar, at least, to the one I have just described. Both of these were interpreted as traumatic.

In my case, as stated above, the long axis of the opening corresponds to the direction of the muscle fibers. The muscle fibers are pulled apart and are not torn. They encircle the opening. This arrangement is much more likely to occur from a tear than in the formation of a defect. I therefore regard the case as an acquired hernia of long standing. The edges of the opening are smooth and even, but this may be the case in an acquired hernia of long standing as well as in congenital hernias. The diaphragm may have been congenitally weak at the place of rupture. After the formation of the tear the negative pressure in the thorax during inspiration would cause the liver to be gradually drawn into the thoracic cavity.

REVIEWS.

THE RECTUM: ITS DISEASES AND DEVELOPMENTAL DEFECTS. By SIR CHARLES B. BALL. Pp. 328; 186 illustrations. London: Henry Frowde, 1908.

THIS is not a revision of Ball's previous book, *The Rectum and Anus* (1887-1894), but is a new work based on the author's Lane Lectures (1902) and Erasmus Wilson Lectures (1903). The 5 plates and 181 illustrations are chiefly from stereophotographs of actual cases or specimens. It is a valuable though not an exhaustive treatise on the subject. Its teachings are in the main in accord with those of most surgeons in this country, and are to be commended. The illustrations add to the value of the text.

Developmental defects are fully dealt with in three chapters. There can be little dissent from the statement that in the many varieties of imperforate rectum and anus the decision as to treatment will depend on whether the obstruction to the fecal current is complete, partial, or associated with a fairly efficient fecal outlet; nor from the general conclusions that in the first case immediate operation is essential to save life, in the second it cannot well be long delayed, while in the third the surgeon may well wait until the child is older, and select his own time for carrying out a well-planned and deliberate operation.

In the chapter on diagnosis, the views of Harrison Cripps as to the slight value of rectal specula as ordinarily used and without anesthesia—though no mention is made of them—seem to be concurred in. The author says of specula: "Personally, I have little reliance on their aid to diagnosis. It is by the sense of touch rather than by sight that disease of the interior of the rectum is best recognized. Some form of duck-bill speculum may occasionally be useful, Hegar's vaginal retractor answering all purposes when it is desirable to see the lower portions of the rectal mucosa. For disease of the bowel higher up, tubular specula, rectoscope, and colonoscope are sometimes used. I seldom employ them, and am somewhat skeptical as to the diagnosis and treatment of high-lying disease of the rectum which we hear of being effected by their means." His further statements that bougies are of little use for diagnostic purposes, although often of service in the treatment of stricture which

is within reach of the finger, and that the attempt to locate by a bougie a stricture too high to be felt with the finger is highly dangerous, will doubtless be concurred in by many surgeons who might not perhaps go so far as to endorse the view of Syme, expressed long ago, that "There is good reason to suspect the honesty of a man who pretends to enter a stricture which is beyond the reach of the finger."

In proctitis the sound advice is given to empty the canal first by simple purgatives—calomel or castor oil—rather than by enemata (which are painful, and may be infection carriers), and to employ the latter later as sedatives or antiseptics, or as both.

His experience with the immediate closure of fistulas by suture has been more satisfactory than has that of the majority of surgeons. He says: "If sufficient care is taken the great majority of cases of fistula can be so closed," that is, with prompt union and without the necessity for re-opening. He has been either very fortunate or exceptionally skilful. He adds, however, that to effect complete cure in a complicated case is a difficult and tedious operation demanding the exercise of considerable patience and attention to minute details. "It is only by thoroughness that one can hope to cure such a case at a single operation." There can, at least, be no doubt as to the accuracy of this assertion.

In the treatment of stricture, he very properly puts dilatation first, and relegates proctotomy—either linear or by external incision—to those cases in which efficient dilatation (preferably by Hegar's dilators) cannot be carried out and excision is impossible. In fissure due to anal "tags"—"sentinel piles"—he has found that moderate dilatation and the removal of the "tag" (usually a torn-down anal valve) by a V-shaped incision with the base toward the ulcer, supplemented by curretting of the latter if unhealthy granulation tissue is present, have been satisfactory in a large number of cases, neither forcible dilatation nor incision of the sphincter being necessary.

The chapter on prolapse contains an excellent summary of all the modern operations of proctopexy, but scarcely enough emphasis has been placed upon the use of the various cauterants, which require no special operative skill, and give good results in average cases.

In the treatment of hemorrhoids, after enumerating the various methods—caustics, injections, electrolysis, the clamp and cautery, excision of the pile-bearing area, etc.—he says that after twenty years' experience and a fair trial of each method, he has come very definitely to the conclusion that by far the best way of removing each separate pile is by a combination of ligature, crushing, and excision. He describes this method in much detail, but it does not differ materially from that of Allingham, in which the ligature is the essential feature of the operation. It has long been in use in this country, and preferred by many surgeons. Cancer, colotomy,

wounds of the rectum, etc., are satisfactorily dealt with on conventional lines.

The author's style is simple and direct, although there are occasional inelegancies that should have been caught in the proof-reading; *e. g.*, "Rectal fistulæ present themselves to our consideration in considerable variety, and from their great frequency and the discomfort they produce, constitute a subject of great interest to the surgeon. It is, therefore, to be little wondered at that, in looking through the voluminous literature on this subject, the names of many of the great masters of surgical art are to be found." These, however, are of minor importance, and the book—which is handsomely made up—constitutes a welcome and valuable addition to the literature of the subject. J. W. W.

THE NATIONAL STANDARD DISPENSATORY: Containing the National History, Chemistry, Pharmacy, Actions, and Uses of Medicines, including those recognized in the Pharmacopœias of the United States, Great Britain, and Germany, with many references to other Foreign Pharmacopœias. In accordance with the Eighth Decennial Revision of the U. S. Pharmacopœia, by authorization of the Convention. By HOBART AMORY HARE, B.Sc., M.D., Professor of Therapeutics and Materia Medica in the Jefferson Medical College, Philadelphia; CHARLES CASPARI, JR., Ph.G., PHAR.D., Professor of Theoretical and Applied Pharmacy in the Maryland College of Pharmacy, Baltimore; and HENRY H. RUSBY, M.D., Professor of Botany and Materia Medica in the College of Pharmacy of the City of New York. With the assistance of Edward Kremers, Ph.D., Daniel Base, Ph.D., and Joseph F. Geisler, Ph.C. Second edition; pp. 2050; 478 illustrations. Philadelphia and New York: Lea & Febiger, 1909.

THE *National Standard Dispensatory* is truly an encyclopedic work. Its general scope, its usefulness, its indispensability are commonly conceded, so that chief interest centers in the publication of a new edition and in how near it attains to that which it professes.

The volume comprises three major departments—pharmacognosy, pharmacy, and therapeutics. Professor Rusby has contributed the sections on pharmacognosy, in which he discusses drugs of great as well as drugs of minor importance. In the discussion of additional species, he refers to the principal economic members of the groups, so that the book is a fair index to the economic botany of all the more important families of medicinal plants. Sufficient information for the practical identification of drugs has been given, rather than full technical descriptions. The illustrations of drugs

have been drawn so as to represent their appearance as they occur in commerce. In order that the reader may find any name which may be encountered in the descriptions of vegetable drugs, nearly all recorded common names of drugs or medicinal plants have been given, and, in addition, all botanical synonyms.

Professor Caspari, in the pharmaceutical sections, has given full information regarding methods and products, with descriptions and explanations of the most approved apparatus and tests—of the greatest value to druggists. Not only have the facts contained in the United States Pharmacopœia been introduced, but also the important facts contained in the new editions of the chief foreign Pharmacopœias. The subjects of alkaloids and fixed and volatile oils have been considered with special detail, and much additional matter relative to new synthetic and other remedies has been incorporated in the book. Valuable assistance in these sections has been rendered by: Professor Base, who has prepared the articles on inorganic chemicals; Professor Kremers, who has prepared the articles on volatile oils and their constituents; and Professor Geisler, who has prepared the articles on organic chemicals.

Professor Hare, in the sections on therapeutics, gives a direct and compact presentation of the actions and uses of drugs—of the greatest value to the physician.

As compared with the former edition, the present is 160 pages larger, embraces 200 new articles, and has been carefully revised throughout. It contains the complete Food and Drugs Act and Regulations, together with official decisions necessary to their interpretation; the National Formulary in abstract, as well as many unofficial formulas widely in use; every article mentioned in the United States Pharmacopœia, with necessary comments and explanations, as well as all the important unofficial drugs and preparations of value; and the Pharmacopœias of Great Britain and Germany, as well as many references to other Pharmacopœias. In an appendix much useful information of a miscellaneous character has been collected. There is, finally, a general index of 121 triple-column pages, which contains the names of drugs and other substances used medicinally in English, French, German, Italian, Spanish, and Latin; and a therapeutic index of 21 triple-column pages, in which, under the names of diseases, are listed all drugs useful in treatment—a repertory of therapeutics of the greatest value to the general practitioner in his daily work.

The *National Standard Dispensatory* assuredly is of the utmost utility to the physician and the apothecary—to all, in fact, who are concerned in any way with drugs and other medicinal remedies. In its new and revised dress, its field of usefulness has become broadened and its value enhanced. Undoubtedly it will long remain the court of final resort in matters relating to pharmacognosy, pharmacy, and therapeutics.

A. K.

THE TREATMENT OF THE DISEASES OF CHILDREN. BY CHARLES GILMORE KERLEY, M.D. Philadelphia and London: W. B. Saunders Co., 1907.

IN the opening chapter the author delivers his opinion in no uncertain terms on "the therapeutic doubt existing at the present time." "Therapeutic nihilism," he says, "as far as pediatrics is concerned, means ignorance and incompetency. The time when a physician can make a diagnosis, and cease his interest in the treatment of the case is past." No detail of treatment is too insignificant for the author's consideration and nothing is left to the reader's imagination. We do not find such phrases as "meeting the indications as they arise," "symptomatic" or "supportive treatment" and the like, which are found so plentifully in many systematic text-books. A very large share of the book is naturally devoted to dietetics, especially infant feeding. In his treatment of this important subject the author differs from many others, chiefly in that he does not limit himself to the description of the best method of substitute feeding only, but, recognizing the impracticability of attempting to prescribe ideal milk mixtures in a great many cases, especially in dispensary practice, provides for this contingency accordingly. Thus dispensary patients unable or unwilling to spend even the small sum of eight cents a day for the baby's milk, or who have no ice-box in which to keep milk in hot weather, are "put into the condensed milk class," the fat deficiency being made up during the colder months by giving cod-liver oil. Each article in the portion devoted to the treatment of special diseases begins with a brief enumeration of the salient symptoms, without any attempt to go into the question of diagnosis, except in a few instances in which the exigencies of the subject render a brief discussion of the differential diagnosis imperative. The actual number of drugs advised in the entire book is small, and many prescriptions are repeated again and again for different diseases. Calomel is not advised nearly so frequently as in most text-books, and its use in some conditions in which it is customarily recommended is absolutely condemned. Castor oil is the author's favorite laxative, and he gives it in large doses. Strophanthus rather than digitalis is advised as a heart stimulant for children on account of the great susceptibility of the digestive tract and the paramount importance of keeping it in working order. Nitroglycerin is also recommended with much insistence in cases showing cyanosis. Very definite directions are given in every instance in regard to dosage, method and time of administration, and length of time during which the exhibition of the drug is required. Lavage, gavage, the preparation and methods of administering laxative and nutritive enemas, hydrotherapeutic procedures, and other practical methods of treatment are explained

in detail and illustrated whenever necessary with photographs. Regarding the practical value of the book there can be only one opinion.

R. M. G.

A TEXT-BOOK OF GENERAL PATHOLOGY. By J. MARTIN BEATTIE, M.D., Professor of Pathology and Bacteriology in the University of Sheffield, and W. E. CARNEGIE DICKSON, M.D., Lecturer on Pathological Bacteriology in the University of Edinburgh. Pp. 475; 166 illustrations. Philadelphia: P. Blakiston's Son & Co., 1908.

DRS. BEATTIE and DICKSON seem to have found some excuse for preparing an additional book on pathology in the fact that it is based upon the teaching of the Edinburgh school, and that some fundamental points, which have been taught at Edinburgh for years, have not elsewhere received sufficient attention. Two are mentioned specifically: infarction and the relation between certain diseases of the kidney and arterial degeneration. Overlooking this perhaps excusable evidence of insularity, one may say that in the book the main facts of general pathology are well epitomized and set forth in a manner adapted for ready assimilation by the student. Bacteriology has been, advisedly, omitted, since it constitutes a distinct subject, albeit inseparable from pathology; the microscopic anatomy of diseased structures has been, inadvisedly, discussed too briefly. It is quite true, as the authors state, that descriptive writing cannot be substituted for the actual specimen and the microscope, but the study of the specimen and the interpretation of the lesions are much facilitated by a lucid description. This, however, scarcely detracts at all from the value of the book, which may be cordially recommended to the student. A companion volume on special pathology is promised shortly.

A. K.

GREEN'S ENCYCLOPEDIA AND DICTIONARY OF MEDICINE AND SURGERY. Edited by J. W. BALLANTYNE, M.D. In ten volumes. Edinburgh and London: William Green & Sons; Chicago: W. T. Keener & Co., 1908.

WE have had occasion several times in the past to comment very favorably upon the earlier volumes of this really excellent *Encyclopedia of Medicine and Surgery*. The work is now completed in ten volumes. Designed to replace the old *Encyclopedia Medica*, this new work contains within its ten volumes not only almost all the articles (revised and brought up to date) that were published in the thirteen volumes of the older work, but also a large number of new

articles on subjects dealt with only cursorily or not at all in the original issue: it contains more than twice as much material—a total of 11,843 articles, of which 609 constitute the encyclopedia and 10,366 the dictionary, while 868 are paragraphs intermediate in size. Aside from mere numbers, the longer articles, as a rule, are of considerable merit, reflecting accurately and in sufficient detail the present state of medicine. The dictionary part of the work comprises only definitions; as we have already said, it would have been materially improved by the incorporation of derivations, orthographical variants, and pronunciations. As a whole, however, the work is complete and authoritative, and may be cordially commended to the profession as fully meeting the claims of the publishers that it constitutes in itself a complete and reliable medical and surgical library.

The publishers purpose shortly to issue a supplementary volume, which they announce as a *Quinquennium of Medicine and Surgery*, since it will contain a record of the advances made in medicine and surgery during the five years that have elapsed since the beginning of the publication of the encyclopedia. The editor promises that this will be something more than a record of the work of five years in medicine: that it will attempt to place new methods and new views in their proper perspective, and will endeavor to distinguish between what is new and of value and what is only novel. Assuredly it will be awaited with interest.

A. K.

THOMAS LINACRE. By WILLIAM OSLER, M.D., F.R.S., Regius Professor of Medicine in the University of Oxford, England. Pp. 64; 11 plates. Cambridge: at the University Press, 1908.

AN ALABAMA STUDENT AND OTHER BIOGRAPHICAL ESSAYS. By WILLIAM OSLER, M.D., F.R.S., Regius Professor of Medicine in the University of Oxford, England. Pp. 334. Oxford University Press, 1908.

THE Sage of Oxford, as he himself acknowledges, has, as a recreation, indulged a life-long interest in biography, and has added thereto a strong conviction of its educational value. In consequence, the literature of medicine, and, indeed, literature in general, has been much enriched by the results of his delvings into the records of the past. These are scattered throughout many periodicals; but some time ago some of them were collected in book form. Now we are thankful for a delightfully told appreciation of Linacre, comprising the Linacre Lecture for 1908, and a volume that takes its title from one John Y. Bassett, a pioneer of Alabama in the early part of the last century. Other of the essays concern Thomas Dover, described as a physician and buccaneer; John Keats, the apothecary poet; Oliver Wendell Holmes, John Locke, Elisha Bartlett, a Rhode

Island philosopher; William Beaumont, a backwood physiologist; Louis' influence on American medicine, William Pepper, Alfred Stillé, Sir Thomas Browne, Frascatorius, and Harvey and his discovery. To all, but perhaps most to the younger members of the profession, these essays should prove a source of inspiration as well as enlightenment. They reflect their author, always a scholar and entertaining, who sees truth and merit, even when more or less concealed by dross, and tells its story with discernment and judgment.

A. K.

SPRUE AND ITS TREATMENT. By W. CARNEGIE BROWN, M.D., M.R.C.P. Pp. 259. London: John Bale, Sons, & Danielsson, Limited, 1908.

DR. BROWN furnishes an interesting and instructive account of sprue, otherwise known as psilosis, chronic tropical diarrhœa, endemic enterocolitis, etc., that should prove of value to all practitioners in the tropics and those who have to deal with patients returned from the tropics, in whom it is becoming increasingly prevalent. There are chapters on the history and literature, the symptoms and signs, the morbid anatomy, pathology, diagnosis, and treatment. The last mentioned is discussed in exhaustive detail—more than one-half of the book being devoted to it. A milk diet, a milk and fruit diet, and a meat diet, in the order named, are believed to constitute the best treatment. Little trust is placed in drugs.

A. K.

NERVOUS AND MENTAL DISEASES. By CHARLES S. POTTS, M.D., Professor of Nervous Diseases in the Medico-Chirurgical College, Philadelphia. Second edition; pp. 570; 142 illustrations. Philadelphia and New York: Lea & Febiger, 1908.

THE first edition of Potts' *Nervous and Mental Diseases* commended itself to a large circle of readers on account of its clear and concise description of clinical conditions, the inclusion of a large amount of essential facts, and the omission of facts of more academic interest than of practical importance. The present edition has been thoroughly revised. The book has been enlarged by about 100 pages, a number of new colored plates have been added, and the section on mental diseases has been practically rewritten to make it conform to the generally accepted and advanced teachings of the day. All the commendable features of the first edition are found in the second—amplified and expanded, so that the book well fulfils its purpose of a manual. It may be confidently recommended as an excellent student's book, and it may also be referred to with

advantage by those in practice desirous of being quickly informed of the salient features of the many disorders of the nervous system and the mind. A. K.

THE TREATMENT OF FRACTURES, WITH NOTES UPON A FEW COMMON DISLOCATIONS. By CHARLES LOCKE SCUDDER, M.D., Surgeon to the Massachusetts General Hospital; Lecturer on Surgery in the Harvard University Medical School. Sixth edition; pp. 635; 856 illustrations. Philadelphia and London: W. B. Saunders Co., 1907.

THE latest edition of this masterly book follows closely upon its predecessors. Compared with the fifth edition, published one year ago, it shows thorough revision and the addition of sixty pages of text and twenty illustrations. The additions to the text consist of a moderately full description of the treatment of certain closed fractures by operation and also of old fractures at the lower end of the radius; a few other operative procedures also are described. Whitman's method in the treatment of fractures of the neck of the femur by forcible abduction and immobilization with or without traction is fully discussed. Especial attention in this edition has been paid to obstetric skull fractures, to fractures of the zygoma, of the malar bone, of the superior maxilla, of the head and neck of the radius, and of the carpal scaphoid; and a discussion of Volkmann's contracture with illustrations has been introduced. Dislocations at the elbow, and at the acromioclavicular joints are more thoroughly treated. A number of new x-ray photographs have been added. The present volume continues to be a guide to the practitioner and student in the treatment of fractures and dislocations, and cannot be too highly recommended. J. A. K.

A MANUAL OF MIDWIFERY. By THOMAS WATTS EDEN, M.D., F.R.C.P. (Lond.), F.R.C.S. (Edin.), Obstetric Physician and Lecturer on Practical Midwifery and Gynecology, Charing Cross Hospital, London. Second edition. Pp. 555; 42 plates and 236 illustrations in the text. Chicago: W. T. Keener & Co., 1908.

THIS volume is a satisfactory treatise on obstetrics from the standpoint of the student. It is not a book which will be found of value to the practitioner of experience as a reference volume. In the main the subject is adequately covered, although there are some statements to which it is necessary to take exception, as for instance, the advice that the urine should be examined monthly during the last three months of pregnancy. If this were a first, instead of a second

edition, we should feel that the author had failed to detect error in his proofreading, since there can be no doubt that criminal negligence is not too harsh a charge if the urine be not examined oftener than the above instructions call for. Again, we cannot agree with him that the Champetier-de-Ribes bag has displaced all other hydrostatic dilators, or, as is implied by inference, that the Milne Murray forceps is to be preferred to the Tarnier model. As the book does not pretend to be an operative manual, the slight and wholly incomplete account of the vaginal Cesarean section may be excused. In his description of abdominal Cesarean section the author advocates the incision of the uterus and its evacuation, before bringing it outside of the abdomen. His method of suture, while better than some advocated in the past, is not entirely satisfactory. It gives satisfaction to find that he warns against profound anesthesia at the time of delivery; that the fallaciousness of the menstrual history as a determining diagnostic point in the diagnosis of extra-uterine pregnancy is insisted upon; that he warns against "supporting the perineum," but insists upon preserving good flexion of the head until the occipital protuberance has escaped; and that he demands that one hour be allowed to elapse before the performance of the Credé method of placental expression. We can recommend the book to the class of readers for whom it was prepared. W. R. N.

A TEXT-BOOK OF DISEASES OF WOMEN. By CHARLES B. PENROSE, M.D., PH.D., formerly Professor of Gynecology in the University of Pennsylvania, Philadelphia. Sixth edition. Pp. 536; 225 illustrations. Philadelphia and London: W. B. Saunders Co., 1908.

As the previous editions of this well-known book have been thoroughly reviewed in the columns of this journal, it hardly seems needful to give it extended consideration at the present time, more particularly since the work in the earlier editions was so well and completely done that but little has been added in those of a more recent date. The book was prepared for the use of students; their verdict is found in the fact that in the past eleven years six editions have been necessary to meet the demand. One of the most admirable points of the book is its accomplishment of the purpose avowed in its preface. In the introduction the author states his purpose to write a book that will present the best teaching of modern gynecology untrammelled by antequated methods of treatment or theories. Those of us who have had occasion practically to commit the book to memory, in the teaching of various classes of undergraduates in the University of Pennsylvania, will bear willing testimony to its conciseness of statement and clearness of description. We believe from personal experience that it is one of the best books published for the use of the undergraduate. W. R. N.

PROGRESS OF MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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An Axillary Diastolic Murmur in Aortic Insufficiency.—R. COLE and A. B. CECIL (*Johns Hopkins Hosp. Bull.*, 1908, xix, 353) note that previous work has shown that the point of maximum intensity of the aortic diastolic murmur is not constant, but varies under different conditions, most authorities placing it in the third and fourth interspace to the left of the sternum and near its margin. Cole and Cecil having noticed the frequency of a diastolic murmur at the apex and in the axilla made a careful study in a number of cases of aortic insufficiency as regards these points of transmission. In all but 2 of 17 cases examined the diastolic murmur was heard outside the apex in the axilla. At times the murmur in the axilla may be of secondary or even, as in 2 cases of maximum intensity, that is, in passing from the point of maximum intensity close to the sternal border, the murmur diminishes in intensity as the apex is reached and then becomes louder in the axilla. Cole and Cecil think that this axillary murmur is of exactly the same kind and quality as that heard at the base; and that inasmuch as it is easily traceable by careful study with a mapping out of the distribution of the aortic diastolic murmur, it cannot be a Flint murmur or a true stenotic murmur transmitted out into the axilla. For this murmur they suggest the term "aortic axillary diastolic" murmur.

Paralysis of the Left Auricle in Mitral Lesions.—JOACHIM (*Deut. med. Woch.*, 1908, xxxiv, 2207) calls attention to the fact that the presystolic murmur of mitral stenosis or the presystolic intensification of a diastolic murmur often disappears when compensation is lost. He has studied the action of the left auricle in four such cases by means of an oesophageal

balloon connected with a tambour. In the tracings which were obtained, Joachim finds no evidence of any auricular contraction. He therefore believes there is a paralysis of the auricle, thus proving Mackenzie's explanation of the disappearance of the presystolic murmur to be correct. His work confirms that of Rautenberg.

The Contrast in the Excretion of Chlorine in Influenzal Pneumonia and in Ordinary Acute Lobar Pneumonia.—L. G. ROWNTREE (*Johns Hopkins Hosp. Bull.*, 1908, xix, 367) notes that the retention of chlorine in cases of influenzal pneumonia is not nearly so marked as is usually the case in acute lobar pneumonia. Uncomplicated influenzal pneumonia may show a normal daily excretion of chlorine, and if reduced, the reduction may not be very great and does not remain low. There is a tendency for the amount of chlorine in 10 c.c. of urine and the total daily output of chlorine to run more or less parallel in their fluctuations. The quantity of urine during the course of an influenzal pneumonia is not greatly diminished, but shows a slight tendency to decrease in quantity during convalescence, while the amount of chlorine may be steadily increased to normal. In influenzal pneumonia a large quantity of urine is not usually associated with a markedly low amount of chlorine in 10 c.c. of urine, as is usually the case in ordinary lobar pneumonia.

A New Sign for the Detection of Malingering and Functional Paresis of the Lower Extremities.—C. F. HOOVER (*Jour. Amer. Med. Assoc.*, 1908, li, 748) asserts that as this sign of "complimental opposition" depends on a normal function always exhibited in healthy persons and invariably present in the sound leg by patients suffering from hemiplegia or paresis of the other, due to some pathological lesion, it is of some importance and of very broad application. The sign is as follows: If a normal individual lying in a dorsal position on a couch be asked to lift one foot with the leg extended, the heel of the other foot will be observed to dig or press into the couch and the extent of pressure may be determined by placing the hand under the tendo Achillis of that side; thus the heel of one foot is employed to fix a point of opposition against the couch during the effort at lifting the other leg; this always occurs if a healthy person makes a free and uninhibited effort to raise the leg. In the reverse order the same principle holds true, for if a person is requested to press the foot or leg against the couch there will be a counter lifting force in the other leg. In patients with hemiplegia or monoplegia of one leg, in attempting to elevate the extended and paralytic leg from the couch the normal foot exhibits the same sign, as above, whether there is any voluntary muscular strength exhibited or not in the affected side. On lifting the normal leg against resistance, however, he will exhibit an opposition with the paralytic leg directly proportional to the voluntary muscular strength he is able to employ when a display of voluntary muscular power in the paralytic leg is exacted. Hoover has found this sign present in a large number of hemiplegic patients, and reports four instances of supposed paresis in malingerers and hysterical subjects, with a quick disproof of their supposed affection by this sign. In these cases it is important that the person examined be unfamiliar

with the test and that his attention fixed on the paralytic leg so that no voluntary cerebral inhibition on his part may interfere with the test.

Working with this same sign, J. LEHERMITTE (*Sem. méd.*, 1908, xxviii, 565) reports upon its use in a number of cases of organic hemiplegia and confirms Hoover's assertions. He thinks that the sign throws much light on the mechanism of hysterical paralysis, as the feeling of the movements of the muscles by the hand under the leg, even in those cases incapable of any volitional movement, shows that in hysteria the subconscious movements are retained unimpaired, while those under control of the will only are suspended. The mechanism of hysterical paralysis is of a different order from that of organic paralysis and in the first the trouble is not the consequence of a functional disorder limited to a definite anatomical system, but is the result of a psychic disturbance, and thus is essentially the creation of the mind. He thinks this sign is due to a natural subconscious effort to maintain static symmetry in the pelvis as the leg is lifted. The digging of the leg into the couch does not help to lift the leg, but helps to maintain this balance.

Alimentary Galactosuria in Icterus.—BAUER (*Deut. med. Woch.*, 1908, xxxiv, 1505) published observations on alimentary galactosuria in normal individuals and in many diseased conditions, showing that galactosuria is present very frequently in cases of cirrhosis of the liver. His experiments have been continued in jaundiced patients. He gives 40 grams of galactose in 400 to 500 c.c. of tea early in the morning on the fasting stomach, and then estimates quantitatively the amount of galactose which reappears in the urine. He finds that alimentary galactosuria is a constant symptom of catarrhal jaundice and cirrhosis of the liver, while in normal individuals and a great variety of diseases it is lacking. In jaundice due to gallstones and to malignant disease, it is usually absent, and when present, is very slight. Because of the difficulty of diagnosis and prognosis in many cases of jaundice the method may be of value.

The Increase of the Gastric Secretion during Menstruation.—WOLPE (*Deut. med. Woch.*, 1908, xxxiv, 2208) has made a comparative study of the gastric juice during and after menstruation in a variety of stomach diseases and in normal individuals, and has obtained the following results: (1) At the time of menstruation the free hydrochloric acid and total acidity of the gastric juice are increased. (2) The secretory activity of the stomach is also stimulated and more gastric juice is produced than normally. In many cases in which hypersecretion already existed a true gastrosuccorrhœa ensues temporarily. (3) The motor power of the stomach is considerably lessened during menstruation. (4) The changes enumerated are doubtless of a purely nervous origin, reflex in nature. The most important practical lesson to be learned from these studies is to avoid the pre-menstrual and menstrual periods in giving test meals for diagnostic purposes.

The Flexor Reflex of the Fingers in Hemiplegia.—JACOBSON (*Deut. med. Woch.*, 1908, xxxiv, 1971) refers to the very great value of the

Babinsky reflex in the diagnosis of lesions of the pyramidal tracts, and remarks that little attention has been given to the reflexes of the upper extremity. Those which have thus far been studied have not a value commensurate with the Babinski plantar reflex. Jacobsohn has studied the fingers in hemiplegics and finds a volar flexion of the fingers on the affected side comparable to the dorsal flexion of the toes in such patients. When the volar flexion is very marked, the finger tips are pressed against the palm of the hand. In such cases the patient is able to extend the finger slightly, if at all, since a permanent contracture exists. In other cases the flexion is less marked and often is entirely lacking. The freedom of motion of the fingers and hands is usually directly proportional to the degree of contracture. To elicit the reflex which Jacobsohn has discovered in the fingers of hemiplegics, one proceeds as follows: The examiner stands on the side of the patient which is affected, and the patient's arm rests on the hand of the examiner so that the thumb is on the outer side. One now taps on the lower end of the radius or in its neighborhood, and if the reflex is positive, a definite flexion of the fingers, especially of the terminal phalanges, results. In other cases (negative) the fingers remain extended. Jacobsohn finds the reflex constantly present in typical cases of hemiplegia, both mild and severe, and it is especially helpful in the mild ones. The reflex runs parallel with the Babinski sign in hemiplegia. In some cases of neurasthenia in which all the reflexes are exaggerated, Jacobsohn has found a slight flexion of the finger and hand after percussion of the radius. But this is eliminated when the patient is told to extend the fingers well.

Hysterical Paroxysmal Œdema.—F. H. EDGEWORTH (*Quart. Jour. Med.*, 1909, ii, 2135) attempts to differentiate from the large and indiscriminate class of cases, sometimes called "angioneurotic œdema," a group which is of hysterical origin and which is characterized by the repeated occurrence of transitory œdema affecting "geometrical" or segmental areas of the body surface, associated in some cases with disturbance of sensation, hysterical in type. Edgeworth reports several such cases in which were presented the features of a subcutaneous œdema of fairly sudden onset, the whole area becoming affected uniformly at the same time; the surface of the skin was generally natural in color, but in some instances was hyperemic or white and cold or purplish; the œdema at its height was firm and non-pitting, later during subsidence it became softer; the edge was always abrupt. There was no pain, only a mechanical inconvenience, and the duration was usually from eight hours to two days. The areas corresponded to the natural divisions of the body, *e. g.*, the mammal, or with areas covered by articles of clothing, stockings, socks, gloves, etc., that is, with the areas called "geometrical" or segmental by writers on hysterical phenomena. There were some sensory disturbances. This condition must be differentiated from the hysterical chronic œdema of Sydenham and Charcot and the angio-neurotic œdema so well described by Milton, Quinke, and Osler. But by careful attention to the "geometrical" type of the area affected, the abrupt edge, the disturbances in sensation, lack of gastro-intestinal crises, or the presence of other visceral manifestations, Edgeworth suggests that cases of paroxysmal œdema may be divided into

two categories—those of Quincke's œdema (angioneurotic œdema) and those of hysterical origin. The former are allied to Henoch's erythema, the latter to hysterical chronic œdema. The former are probably due to some blood change and the latter to some disturbance in the central nervous system.

Hemoglobin Estimation and the Functional Value of the Hemoglobin.—OERUM (*Deut. med. Woch.*, 1908, xxxiv, 1225) has made comparative studies of the hemoglobin of normal individuals in Berne, Switzerland, and in Copenhagen. In his studies he has used the same Sahli standard tube and compared the results obtained with the von Fleischl-Miescher instrument. In Berne he found that twenty men between the ages of nineteen and twenty-two years had an average hemoglobin of 80.7 per cent. (Sahli). Reckoned in coloring matter for 100 c.c. of blood, this equals 13.8 per cent. hemoglobin. In Copenhagen the average of thirty students was 99.6 per cent. (Sahli). Thus there is a marked difference in values in Switzerland and Denmark with the same Sahli tube. But the Miescher apparatus gave equal readings in both cities. The difference is to be explained by the difference in elevation above the sea. By comparing the readings obtained with the Sahli and Haldane instruments Oerum finds that a given quantity of hemoglobin may show greatly varying powers for absorption of carbon monoxide. Therefore, while the color intensity of the blood of normal individuals in both Berne and Copenhagen is alike, the hemoglobin content of the bloods is different. Comparing the results obtained with Sahli and Haldane's instruments, Oerum reckons the so-called functional value of the hemoglobin, to which he attaches considerable importance.

The Pathogenesis of Ochronosis.—GROSS and ALLARD (*Arch. f. exp. Path. u. Pharm.*, 1908, lxiv, 284) have studied ochronosis experimentally in connection with a case of ochronosis and alkaptonuria which they have observed recently. From the frequent association of the two conditions they assume that homogentisinic acid bore a direct relationship to both. They were, however, unable to extract this acid from cartilage or any other tissue. By placing pieces of cartilage from dogs and calves obtained immediately after death in homogentisinic acid solutions (1 to 10 per cent.), and keeping this at room temperature three to six weeks with chloroform to prevent decomposition, they found the characteristic color changes of ochronosis produced in the cartilage. At first a grayish color appeared on the surface, which gradually increased in intensity and penetrated to a greater depth, until finally the cartilage was deep black. Microscopically, the cartilage was similar to that obtained from patients with ochronosis. Connective tissue which was attached to the cartilage remained uncolored.

The Treatment of Chorea by the Intraspinal Injections of Magnesium Sulphate.—G. MARINESCO (*Sem. méd.*, 1908, xxviii, 553) notes that the beneficial effects in tetanus from the injection of magnesium sulphate reported in the literature led him to use the same in cases of severe chorea, with very beneficial results. The duration of the disease was markedly lessened and there has been no return of the trouble since the treatment.

The injection was 3.5 c.c. of a 25 per cent. solution; the patients were girls between twelve and twenty-two years of age. The sedative action of the drug was noticed a few hours after injection, the symptoms quickly subsided, subsequent injections being required only a few times. The slight untoward effects noted quickly subsided, and no serious results followed. The headaches and pains can be best overcome by a small preliminary dose of morphine. Marinesco says that the best solution for injection is an isotonic one with the freezing point at 0.56, and he is convinced that this method will be very successful in certain well-selected cases.

SURGERY.

UNDER THE CHARGE OF

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Operations on Malignant Tumors of the Stomach and Their Final Results.
—GOLDSCHWEND (*Archiv f. klin. Chir.*, 1908, lxxxviii, 218) says that 333 cases of benign and malignant diseases of the stomach (chiefly ulcers and cancers), were operated on in the surgical department of the Linz General Hospital in the last twenty years. About two-thirds of these were operated on in the last ten years. Notwithstanding all the efforts that have been made to establish the early diagnosis of cancer of the stomach, it is generally conceded that although it may be suspected frequently it can not be positively diagnosticated. In a large number of cases the tumor is first recognized only when it is too far advanced to permit a radical removal. The total mortality from operation in 179 cases of cancer of the stomach, radical and palliative, was 35 per cent. That for resection and gastro-enterostomy was approximately the same (36 per cent. and 35.5 per cent.). It should be borne in mind, however, that in many cases in which gastro-enterostomy was the operation performed, the very advanced stage of the disease influenced the mortality very unfavorably. The average duration of life (recurrence) was fifteen months and twenty days. After gastro-enterostomy it was six months and ten days. After resection, 19 (23 per cent.) were discharged cured. 11.4 per cent. of the whole number operated on remained cured (the oldest remaining eight years free of recurrence). Resection by Billroth's second method, with anterior antecolic gastro-enterostomy, gave the best results (mortality, 15 per cent.). In palliative operations, on the contrary, posterior retrocolic gastro-enterostomy is to be preferred. Careful clinical examination of the stomach is necessary in order that the case may be passed over to the surgeon as early as possible. Whenever a carcinoma is suspected an exploratory laparotomy should be done.

The Mechanics of the Cerebrospinal Fluid and its Employment in Lumbar Anesthesia.—PROPPING (*Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1908, xc, 441) makes the following practical applications of the results of his study of this subject. Elevation of the pelvis, just as does the sitting position, causes a movement of the cerebrospinal fluid in the subarachnoid space, although this is relatively slight. We have no means of determining the quantity of cerebrospinal fluid present or its distribution. It is advisable not to withdraw large quantities of the fluid, since we do not know in what relation the withdrawn fluid stands to the whole quantity present. We must have in mind, in every case, that the anesthetic, by means of the cerebrospinal fluid, reaches the medulla oblongata. How quickly it progresses in each case we do not know. If the anesthetic is a heavy solution of high specific gravity, the diffusion in the horizontal position occurs with relative rapidity. It would appear, therefore, that the head should be elevated after the operation to impede the rapidity of the diffusion. A prolonged elevation of the pelvis after the injection of a solution of high specific gravity, must be regarded as dangerous.

The Conjunctival Reaction of Tuberculin, its Supposed Dangers, and its Value in Surgery.—ZOEPPRITZ (*Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1908, xc, 496) says that a 1 per cent. old tuberculin of Koch, with the established precautions, is without danger. The conjunctival reaction is positive in all uncomplicated, unopened cases of bone, joint, and glandular tuberculosis. In all unopened diseases of the bones, joints, and glands, when the proper technique is carried out and tuberculosis is not present in other parts, the negative result in the conjunctiva is of much importance. It shows that the local affection is not of a tuberculous nature. Oftentimes the strongly marked redness of the reaction is replaced by a more pale-brown color. In recent cases of unopened bone, gland, and joint disease, which give relatively acute symptoms, the pale later reaction obtained under the same precautions as above speaks with more certainty against tuberculosis. Genital tuberculosis comes, as a rule, into the stage of the pale reaction, so that in these cases only a negative result is conclusive. With the pale reaction one cannot exclude here the beginning stage of tuberculosis. In general tuberculosis, namely, of the peritoneum, intestines, lungs, and meninges, as well as in miliary tuberculosis, the reaction is of little value. Little dependence is to be placed on it for fistulous or open tuberculosis.

The Indications for Operation in Biliary Lithiasis.—QUENU (*Rev. de chir.*, 1908, xxviii, 682), quoting Kehr, says that Riedel estimated that there were 2,000,000 cases of biliary lithiasis in the German empire; but that only 100,000 gave trouble. Kehr operated on only 1300 out of 4000 cases which came to him for consultation. The 2700 others he treated medically and expectantly. 80 per cent. of the patients who have had attacks of pain, according to Kehr, again became latent cases, which is equivalent to a cure. According to Riedel's figures, in 1000 cases of biliary lithiasis, 950 are latent and only 50 give symptoms. 80 per cent. of these may become latent later, so that only 10 of the 1000 cases merit operation, or 1 in 100. Quenu believes that stones in the

gall-bladder justify operation only when there are symptoms of complications or the exaggeration of habitual painful manifestations. In grave cases of suppurative or gangrenous perforative cholecystitis the operative mortality remains high. In the less acute, presumably not of the above types, the urgency of operation disappears. One can then, as in appendicitis, treat expectantly, that is, with rest, hot compresses, etc., but one should take into account that attack or a series of attacks in deciding the treatment later. The case may end in a chronic empyema of the gall-bladder, and frequently does end in a chronic inflammation. Operation will then depend especially upon the constitutional symptoms. Repeated painful attacks, recurring at short intervals, and the resulting interference with work, and more particularly recurring fever from time to time, indicating a lighting up of an old chronic lesion, warrant operation. In hydrops of the gall-bladder the rule is to operate, but a sterile hydrops may give only mild disturbances. When the stone is in the common duct, operation is indicated as soon as a diagnosis of chronic obstruction can be made. In order to establish such a diagnosis one should wait until the acute symptoms have subsided, in order that an obstruction of the common duct may not be confused with an attack of angiocholitis associated with stones in the gall-bladder.

Multiple Perforations of the Intestine from Gunshot Wounds of the Abdomen.—SOURDAT (*Rev. de chir.*, 1908, xxviii, 733) says that multiple perforations of the intestines from gunshot wounds of the abdomen are frequent. Whatever their number, they are not beyond the resources of surgery. The early diagnosis of these lesions is difficult, sometimes impossible. We should look upon every gunshot wound of the abdomen as penetrating and complicated by visceral injury, especially by wounds of the intestine, unless we have absolute proof that it is not penetrating. Whenever possible, we should do a median, exploratory laparotomy, without regard to the seat of the wound. The intestine should be explored systematically in its whole extent, with as little evisceration as possible. After repair of the lesion a careful toilet of the peritoneum should be provided whenever there has been a considerable escape of feces.

Supernumerary Kidney Diagnosticated during Life.—CALABRESSE (*Ann. d. mal. d. org. génito-urin.*, 1908, ii, 1841) says that the literature on this subject is scanty. A woman, aged fifty-five years, had complained of epigastric pain for only two months. The pain was at times mild and at other times so acute that the pressure of the clothes could not be tolerated, and vomiting occurred. A movable right kidney which gave no pain was diagnosticated. On the left side a similar condition of the kidney was discovered. On pushing this kidney back into the left renal fossa, there could be felt below its lower pole an oval body about the size of a chicken's egg, hard, smooth, mobile, and separated from the right upper body by an appreciable groove. The diagnosis of nephroptosis was easily made, but it was not easy to decide the character of the lower body. It was thought to be a supernumerary kidney. Operation was done only on the left side, as the symptoms appeared to come only from that side. A lumbar incision exposed the

kidney, and a small supernumerary kidney was disclosed below the lower pole of the upper or normal kidney. Both of these kidneys were attached to the abdominal wall by flaps made from the detached capsule and sutures. Complete cure followed.

Temporary Occlusion of the Colon for Resection or Shutting off the Function of the Lower Bowel.—WILMS (*Deut. Ztschr. f. Chir.*) says that our only method of excluding the large bowel, especially the sigmoid flexure and rectum, in inflammatory conditions, such as those from gonorrhœal, syphilitic, and dysenteric diseases, is by a colostomy. This can completely prevent the passage of the contents to the part below the colostomy opening only when an effective artificial anus is made. This means that a separating spur must be made between the two limbs of the bowel loop brought out and sutured to the margins of the abdominal wound. Wilms conceived the idea of providing a temporary complete occlusion of the bowel below the opening in the intestine. It would then be sufficient to make a lateral attachment of the bowel at the site of the opening in it to the abdominal wound. Later, when the necessity of the bowel occlusion and colostomy had passed, the occlusion could be removed and the fistula be given an opportunity to close spontaneously. In 8 cases Wilms proved the value of his method, which was carried out as follows: A rather strong piece of wire was bent into the shape of an ordinary hairpin, or a hairpin itself was employed. The part of the intestine below the site of the colostomy opening was drawn between the limbs of the pin so that one end of the pin passed through the mesentery and both ends lay on the same side of the mesentery. The two ends of the pin were then forced toward each other, by forceps or the fingers, tightly enough to close the lumen of the bowel effectively, but not so tight as to injure it. In order to provide continuous and equable pressure for the desired period, which might be weeks or months, the two ends of the pin were fastened together by a silk or linen thread wrapped around the ends of the pin. The thread was then tied to the loop end of the pin. The pin may be so placed as to be visible in the wound or, what is better, it may be buried in the wound and the ends of the thread left outside. Above, on the stomach side of the occlusion, a lateral colostomy was performed in the usual manner. The opening should be large enough to provide a free escape of the feces. Wilms opened the bowel twelve to twenty-four hours after the operation. When it is necessary to remove the occluding pin, the thread leading to the free ends of the pin was cut, and the end fastened to the loop end of the pin was drawn on and the pin thus removed. Wilms has employed this method with much satisfaction in the treatment of inflammatory conditions of the lower bowel and for the excision of carcinomas, the exclusion of the feces offering a very desirable advantage in either case.

A Contribution to the Etiology and Treatment of Inflammatory Stricture of the Rectum.—GAUDIANI (*Deut. Ztschr. f. Chir.*, 1908, cvi, 230) says that from the etiological standpoint the conclusion can be drawn that stricture of the rectum is not due to any one cause. Syphilis, gonorrhœa, and tuberculosis are the most common causes. A definite

dysenteric origin is difficult to establish. Gaudiani's observations and those of other writers show that the histological examination does not always lead to definite conclusions concerning the pathogenesis. The changes in the bloodvessels observed by Gaudiani and Rieder point definitely to syphilis. Rectal tuberculosis is more frequent than has hitherto been observed. Gradual dilatation in mild cases and in the early stages gives good results. In advanced cases operation is the only choice, and this should consist almost always of resection or amputation. An artificial anus is necessary for relief in these cases.

The Treatment of Angioma with Frozen Carbonic Acid.—SAUERBRUCH (*Zentrbl. f. Chir.*, 1909, xxxvi, 1) reports his results from the application of a method observed in the Augustana Hospital in Chicago, where it was employed by Ochsner. A strong stream of carbonic acid gas from a tank, such as is used with the freezing microtome, was passed through a piece of gauze held in front of it. The rapid evaporation left on the gauze an even layer of white snow at a temperature of 79° below zero. A small piece of this snow was placed on the surface of the angioma and allowed to remain ten to twenty seconds. The cold produced a marked degree of contraction of the vessels and a circumscribed anemia of the tumor, which was surrounded by a hyperemic area. At the same sitting two or more applications of the snow were made in different places, but no bandage was applied. This treatment was repeated at intervals of eight to ten days until the tumor had disappeared. Sauerbruch has verified the method throughout. He saw two angiomas about the size of a dollar, one on the forehead, the other on the arm, become smaller after three treatments and completely disappear after five treatments, without leaving any scar. A large angioma at the root of the nose, which had shown only slight contraction after many treatments during a year, was strikingly improved after three treatments with the frozen carbonic acid. Other cases showed similar results. In large angiomas the snow should be applied for longer periods (thirty to forty seconds) and mild pressure should be employed. This leads to the formation of a slough which will be replaced by cicatrization in about eight days. The cosmetic effect is good and the method is painless. Sauerbruch has also employed it with good results in epitheliomas of the face.

Drainage of the Common Bile Duct after Operation.—KEHR (*Zentrbl. f. Chir.*, 1909, xxxvi, 3) says that by the usual methods of draining the bile ducts almost all the bile escapes externally and the intestinal tract is deprived of it, so that many patients operated on suffer severely. Recently Kehr has employed the following method in 10 cases: A thin rubber drainage tube of a 'T' form is employed. The one end of the horizontal limb of the tube is passed about 2 cm. in the direction of the duodenal end of the common duct and 2 cm. in the direction of the liver. The vertical limb is brought out of the abdominal wound. The tube is fixed to the edges of the opening in the duct by two stitches. Considerable difficulty was experienced in removing the tube on account of the stitches and the branches of the 'T' in the duct. Another difficulty was experienced in one case. The limbs of the tube were fused

together at their junction, and bile passing through and around the portion of the tube in the duct had dissolved the connection, so that on the withdrawal of the vertical portion the other piece remained in the duct, and had to be removed at a second operation. After this experience, for security, both portions were further united by a silk ligature. Kehr has further modified the tube so that the portion of the horizontal tube passing toward the hepatic duct is 1.5 cm. long, and that toward the duodenum 0.5 cm. This renders its removal more easy. The opening in the common bile duct is narrowed to the tube by suturing the opening in the duct on the side of the hepatic duct to the tube. In the first five days almost all the bile flows outward through the wound. On the sixth day the outside tube is clamped or tied shut, so that the bile is forced onward to the duodenum. This occurred in all the 10 cases. If there is an obstruction of the duct on the duodenal side the bile will escape from the external wound alongside the tube and the abdominal cavity will be protected by adhesions. The T tube is removed in ten to fourteen days. In the last case operated on, on the sixteenth day, the opening in the duct was closed, as was shown by the fact that no bile escaped.

Operations on the Biliary Passages.—MIZOKUCHI (*Deut. Ztschr. f. Chir.*, 1908, cvi, 422) made a study of seventy operations on the biliary passages, performed by Professor Omohri at Fuokoki. He says that gallstone disturbances are much less frequent in Japan than in Europe and up to the present time relatively few operations have been done for them. The type of case differs also. According to German writers the stones are usually formed of cholesterin, women are the most frequent sufferers, and the stones are found most frequently in the gall-bladder. His experience with 41 cases of pure gallstones differed from this. Males were more frequently attacked than females, the stones were found much more frequently in the common duct and they consisted mostly of bilirubin and were very brittle. In 43 cases the stones were examined qualitatively. In 9, pure cholesterin stones were found, 6 in the gall-bladder and 3 in the common duct. Three intrahepatic stones were of bilirubin and were almost free of coloring matter; 17 of the 43 contained chiefly bilirubin calcium with traces of cholesterin and a calcium soap. The remaining stones were formed of a compound mixture. A pure mineral stone was not found, although in all there was some iron, and in most of them a surprising amount of copper. In 6 cases ascariides were found. In one the bile-stained worm was found in the cystic duct, and in another some time after operation a living worm escaped from the gall-bladder fistula. In a third, from the common duct filled with thick bile, there were removed five dead and one living worm; in a fourth, which came to autopsy eight days after operation, there were found three dead ascariides as well as gallstones in the bile passages of the left lobe of the liver. In a fifth case there was a living worm in the hepatic duct; and in the sixth there was found, adherent to the surface of a very large stone removed from the common duct, a dead worm. In another case, in which a choledochotomy was performed for severe colic, ascariides were found but no stone. Of the 41 patients operated on, 8 died, and of these,

in 4, stones were found in the liver. The preponderance of bilirubin stones is explained by the vegetable diet of the Japanese. Much tea is used and very little alcohol in the form of rice wine (sake). The frequency with which stones were found in the common duct and liver is explained by the late period in which the patients came to operation. Of the 41 pure gallstone cases, in 22, or 53.6 per cent., the stones were found in the common duct, and in 18, or 44 per cent., in the cystic duct or gall-bladder.

THERAPEUTICS.

UNDER THE CHARGE OF

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Further Observations on the Importance of Cellulose in the Diet of Diabetics.—SCHMIDT and LOHRISCH (*Deut. med. Woch.*, 1908, xlviii, 2012), in a previous communication (*Deut. med. Woch.*, 1907, xlvii), advocated the use of cellulose in the dietetic treatment of diabetics. In the present papers they reiterate their former conclusions with some additional observations. Their earlier observations were mainly with cellulose derived from white cabbage. They have found that a preparation of cellulose from agar-agar is better tolerated and supplies more nourishment than cellulose derived from white cabbage. The preparation is a yellow powder, a hemicellulose, neutral in reaction, smelling and tasting like malt. Dissolved in cold water, the preparation has a prompt reducing action and will deflect light slightly to the left, but is non-fermentable. After boiling or hydrolysis with hydrochloric acid light is deflected to the right, and tests show that the sugar formed is galactose. Their experiments showed that agar-agar formed galactose from the hemicellulose, galactan. This is very slowly broken up and absorbed, and this slow gradual assimilation is the principal reason for its toleration by the diabetic; 50 to 100 grams of the preparation of agar-agar with furnish 20 to 40 grams of galactan. Moderate doses give no ill effects, at most causing more or less fluid stools. Larger doses may cause diarrhoea and flatulence. They believe that 60 to 75 per cent. of the preparation is absorbed. No increase in the amount of sugar or acetone occurs in the urine after its use.

Gastric Ulcer.—KATZENSTEIN (*Berl. klin. Woch.*, 1908, xxxix, 1749) has performed some interesting experiments which, he thinks, add some facts to explain the etiology of gastric ulcer. In an earlier paper (*Deutsch. med. Woch.*, 1907, iii and iv) he has shown that the beneficial effect of gastro-enterostomy is largely due to the fact that alkaline fluids enter the stomach and thus favor the healing of the ulcer. In one of his experiments Katzenstein made two wounds, one in the stomach and the other in the bowel, and cauterized both with hydrochloric acid.

The stomach wound healed in two days, while the intestinal wound perforated. He thinks that this result indicated that the stomach possessed some protective substances against the action of hydrochloric acid. He stitched a loop of the intestine so that it projected into the stomach, and this loop was digested. A portion of the spleen similarly placed was also digested. On the other hand, a fold of the gastric mucous membrane or a piece of the duodenum resisted the action of the gastric juice. Similar experiments *in vitro* gave the same results. Portions of gastric or duodenal mucous membrane were not digested, while pieces of other tissues were. Furthermore, the presence of pieces of gastric mucous membrane served to protect other tissues against artificial digestion. Therefore he believes that even the dead gastric mucous membrane contains some substance which acts as an antiseptic agent. He has succeeded in isolating this protective substance or antipepsin. He believes that it may be of great value in the treatment of gastric ulcer on the assumption that there is a deficiency of antipepsin in that disease.

The Therapeutic Use of Bromides upon an Experimental Basis.—WYSS (*Med. Klin.*, 1908, xlvii, 1794) has performed experiments on animals producing serious symptoms by the administration of bromides. The animals develop ataxia progressing to fatal paresis. He explains this train of symptoms, which are ordinarily regarded as bromide poisoning, by a chlorine deficiency. It is most interesting to note that it was possible to save these animals by the injection of sodium chloride. They recuperated entirely in twenty-four hours with no sign of their previous serious condition. He believes that continuous administration of the bromides causes a considerable retention of bromine ions in the blood. Consequently sodium chloride is excreted in order to prevent the concentration of salts in the blood. The deficiency of the chloride leads to serious consequences, which may be relieved by the injection of normal saline solution. He applies his findings to the treatment of epileptics in the clinic. This is accomplished by the administration of bromides and the simultaneous reduction of salt in the food. Salt is absolutely prohibited, however, only in urgent cases, and then only for a short time. By this method the effect of the bromides is more rapidly obtained, and less amounts are required for efficient therapeutic results.

The Vaccine Treatment of Typhoid Fever.—WATTERS and EATON (*Med. Record*, 1909, iii, 93) report 30 cases of typhoid fever treated by vaccines. They noted, in many of the cases, a period of aggravation, the "negative" phase, followed shortly by a period of amelioration, the "positive" phase. Occasionally they were able to determine a very transient amelioration followed by the usual manifestations of the "negative" and "positive" phases. It seemed to them that the best results occurred in those cases in which a brief "negative" phase occurred. They had two deaths in the 30 cases treated. One of the fatal cases had been ill a month before the treatment was begun and was practically beyond help. This leaves one fatality in a case in which treatment was begun at the end of the second week. They believe that the earlier the treatment is begun the better the prognosis. They

say that the number of cases thus treated is, of course, too small to justify any absolute conclusions. However, the effects in the individual cases were so noticeable that it seemed wise to publish them in order to stimulate the use of the vaccines by other observers. The beneficial effects upon the temperature were notable, and they have included in their report the individual temperature charts.

The inoculations were made into the subcutaneous tissue overlying the biceps muscle and consisted of a stock emulsion of typhoid bacilli standardized and sterilized by moist heat at 60° C. for twenty minutes and by the addition of 0.3 per cent. of lysol. They gave it in doses of from 15 to 50 minims, the average dose being 25 to 40 minims. Judging from their own experience, they would advise its use in larger doses.

The Treatment of Gout by Thyminic Acid.—FENNER (*Lancet*, 1908, ii, 1804) has obtained good results by the use of thyminic acid in the treatment of gout. He believes that the use of thyminic acid to hasten the elimination of uric acid rests upon a scientific basis. Thyminic acid, as well as uric acid, is produced by the oxidation of the purin bodies. It forms a combination with uric acid which is soluble and which cannot be precipitated. He believes that uric acid normally circulates in the blood in this combination. In gout, he thinks, there is some fault with the combination of uric acid and thyminic acid, though the amount of uric acid in the blood may not be increased above the normal. Therefore, if thyminic acid can be supplied to the blood by ingestion or by any other means in sufficient amount to retain the uric acid in solution, attacks of gout will be prevented. Thyminic acid is now prepared synthetically, and Fenner advocates the daily use of 4 grains, taken after meals for a period of three months and then every alternate week, to prevent the onset of acute symptoms. He believes that it is especially suitable for the prevention of acute exacerbations of chronic gout and for the gradual improvement of the symptoms of a chronic or irregular gout. Thus he has found it particularly useful in the treatment of obesity, so often allied with gout, and in the manifestations of irregular gout, such as eczema, asthma, glycosuria, and stomach disorders. For the acute attack, thyminic acid is not invariably successful and he prefers to use in such cases mercurials with colchicum or colchicum with aspirin. After the acute attack has subsided large doses of thyminic acid should be given together with appropriate local treatment.

Some Indigestible Carbohydrates in the Digestive Tract.—MENDEL (*Zent. f. d. ges. Phys. des Stoffw*, 1908, xvii, 641) reviews the literature concerning the nutritive value of carbohydrate foods which contain substances closely allied to cellulose and are chiefly derived from lichens and algae. Among these are Iceland moss, agar agar, Jerusalem artichokes, dulse, and salep. These contain various polysaccharides of complex structure, having the class name hemicellulose, which are more or less closely allied to one another. They are used for food in the regions where they naturally occur and have been advocated by many observers to supply the carbohydrate loss in diabetes. It is a well-known fact that the action of the enzymes which split up carbohydrates, is a specific one for the different polysaccharides. Mendel

does not believe that enzymes for the splitting up of these complex polysaccharides exist in the human economy. Consequently, he does not believe that their carbohydrate content can be hydrolyzed into the diffusible sugars. It is commonly understood that man cannot utilize cellulose because he is not provided with suitable digestive enzymes. The carbohydrates of the lichens and the algae seem to be allied in their chemistry closely to cellulose. There seems to be little reliable evidence concerning the digestibility of these carbohydrates, but that which we have is largely negative. A number of observations have been made with inulin. Levulose may be obtained from inulin by hydrolysis with acids. Since some diabetics tolerate levulose better than dextrose foods containing inulin have been recommended in the treatment of diabetes. Experiments have shown that salivary, gastric, pancreatic, and intestinal juices all fail to hydrolyze inulin. In addition, inulin, when fed to animals, does not increase the glycogen content of the liver as levulose does. It seems that the inulin is either not utilized at all or very slightly, and it is, therefore, not strange that clinicians should find no increase of glycosuria after its use. Similar results have been obtained with the polysaccharides derived from algae and lichens. Saiki examined a number of preparations of these classes in Japan, where they are widely used as food, and found that they are utilized very poorly for the purpose of nutrition. It has also been demonstrated that Iceland moss resists the action of the intestinal bacteria. Mendel suggests that further work should be done to ascertain the action of certain vegetable enzymes in hydrolyzing these polysaccharides. Mendel's own experiments showed that the greater part of these carbohydrates is excreted in the feces, unchanged. He attributes the good effects of agar agar in chronic constipation to this fact. Mendel believes that the results of the experimental studies should warn against the hasty acceptance of every carbohydrate foodstuff, as a food possessing a real nutritive value. The nutritive value of any food can be established only by accurate metabolic work. He adds that many of the group discussed form palatable accessory articles of diet both in health and disease.

Etiological and Therapeutic Researches in Pernicious Anemia.—REICHER (*Berl. klin. W'och.*, 1908, xli, 1838, and xlii, 1893) reviews the many different theories of the etiology of pernicious anemia and characterizes most of them as unsatisfactory, or at least questionable. He speaks most favorably of the hemolytic theory, and quotes the work of many observers which tend to support this view. These quoted observations have to do with anemias which are caused by different, though apparently related, substances. He speaks especially of the theories of the production of anemia by more or less closely allied lipoid substances. Considerable work has been done to point out the relation of a hemolytic substance as a cause of the anemias of the intestinal parasites. A similar explanation has been advanced to explain the anemia of carcinoma. He quotes the experiments of Keyes and Sachs, who prevented the hemolytic action of cobra lecithid *in vitro* by cholesterin. Reicher was able to cause a remarkable improvement in the anemia, produced by cobra lecithid by treatment with cholesterin, and thus he

was led to try cholesterin in pernicious anemia. Certain observers have found that when cholesterin is given by the mouth, the cholesterin content of the blood is raised. Others have found a diminished amount of cholesterin both in the red blood cells and in the serum of the blood of pernicious anemia. He used a 3 per cent. solution of cholesterin in hot olive oil. This solution remains stabile when cold, but becomes cloudy. This cloudiness will disappear on warming. A few drops of oleum menthæ will improve the taste. It should be given in tablespoonful doses, so that during the day 100 c.c. is given. The medication is well borne by the stomach. It should be given in oil, because when given in a watery emulsion it is quickly excreted in the feces. Reicher gives the detailed histories of four cases in which he used cholesterin with good results, and thinks that a larger experience will justify its more frequent use.

PEDIATRICS.

UNDER THE CHARGE OF

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The Heart Lesions of Infancy and Childhood.—I. A. ABT (*Archives of Diagnosis*, 1908, i. 127) states that the first heart sound in children is normally louder than the second. Accentuation of the second pulmonic sound, if constant, is always a pathological sign. Accidental heart murmurs occur less commonly than in adults. Endocardial heart murmurs are usually soft, short, and blowing. Prominent causes are acute rheumatism, tonsillitis, chorea, pneumonia, and scarlet fever. Probably 40 per cent. of the cases are pure mitral regurgitation, while double mitral disease occurs in probably 30 per cent. of the cases, pericarditis in 20 per cent. The latter is a very grave condition and death results quite frequently either during the acute illness or is due to associated endocarditis and the pericardial adhesions. Endocarditis also offers a grave prognosis, especially in early childhood. Aortic insufficiency presents the gravest prognosis, mitral insufficiency the best.

Acute Anterior Poliomyelitis.—L. S. ARCHAMBAULT (*Albany Medical Annals*, 1908, xxix, 941) reports the case of a girl, aged ten years, in whom the use of the right arm was suddenly lost at the age of eighteen months. The child had been slightly feverish a few days prior to the onset of the paralysis, but there were no convulsions, no vomiting, no diarrhea, nor any other of the symptoms commonly observed in the initial stage of acute anterior poliomyelitis. For a time she was also weak in her feet. At the time of the report the child could perform all movements of the arm with the exception of the movements performed by the deltoid muscle. This muscle was totally disabled; it was completely wasted and did not respond to either faradic or galvanic stimulation, even though a very strong current was employed. There were no trophic or vaso-motor disturbances. The biceps was also slightly weakened.

The Value of Spinal Puncture in Diagnosis.—M. H. FUSSELL (*Archives of Diagnosis*, 1908, i, 176) describes the technique of spinal puncture thus: A sharp, hollow needle, three to four inches long, and a little smaller than an ordinary matchstick, is the instrument employed. Strict asepsis is enjoined. The patient should lie on his side with spine bent forward as much as possible and legs drawn up. The puncture is made close to the spinous processes between the second and third or third and fourth lumbar vertebræ. The needle should be held perpendicular to the spinal column, plunging thus through the skin; then the needle should be turned slightly upward and toward the centre; it at once slips into the spinal canal, but if not, it must be pushed in different directions until the aperture is found. If blood stops up the needle, the clot must be displaced with an obturating wire. Wherever the symptoms point to meningitis, this test should be performed. If done aseptically, it is a dangerless operation. Five cases are quoted; in one of these the examination of the fluid revealed epidemic cerebrospinal meningitis; in one, tuberculous meningitis; one proved to be negative, one proved to be pneumococcic cerebrospinal meningitis; and the last was a staphylococcic meningitis following a middle-ear suppuration. None of these cases could be diagnosticated definitely until after the spinal fluid was examined, and there was a great resemblance between several of them.

The Leukocyte Count of Normal "Institutional" Children and Those Suffering with Pertussis.—H. O. MOSENTHAL (*Archives of Pediatrics*, 1908, xxv, S31) made a number of leukocyte and differential counts at the New York Foundling Hospital of normal children and of others suffering with whooping-cough, and formulated the following conclusions therefrom. The average normal leukocyte count of "institutional" children is 13,850 to 16,391, somewhat higher than that usually given. The normal leukocyte count for these cases varies between extremely wide limits (29,600 and 7000). The percentage of various kinds of leukocytes in "institutional" children shows a slight diminution in the number of polymorphonuclear cells, with a corresponding increase of the mononuclears as compared with other figures. The percentage of polymorphonuclear cells increases with age in the same ratio as that given for other normal children. The percentage of eosinophile cells is within normal limits. During the catarrhal stage of pertussis an increase is seen in the leukocytes approximating double the normal, and the number of mononuclear cells is increased about 5.5 per cent. at the expense of the polymorphonuclear cells. In the convulsive stage similar, though less marked, changes occur in the blood count. Other cases, which have an afebrile cough but do not develop pertussis may show a hyperleukocytosis. When this is the case, there is a marked increase in the number of polymorphonuclear elements at the expense of the mononuclears. A hyperleukocytosis coupled with an increase in the percentage of mononuclear cells at the expense of the polymorphonuclears is a distinct aid in the diagnosis of pertussis during the catarrhal stage.

Scarlet Fever.—RUBENS (*Berl. klin. Woch.*, 1908, xlv, 1886) believes the tonsils and pharynx to be the portal of entrance for the causal

agent of scarlet fever. The angina is usually necrotic, and the amount of mucus at times so great as to threaten the patient with asphyxia. He has never been able to cultivate diphtheria organisms from the throats of scarlet fever patients, whether the cultures were taken early or late in the course of the disease. Neither has he ever been able to see any benefit from the injection of diphtheria antitoxin. He therefore does not believe in the existence of diphtheroid cases of scarlet fever. When death occurs within a short time after the onset of the disease, he believes the cause to be the action of the toxin on the heart. The prognosis usually goes hand in hand with the severity of the angina. The treatment should endeavor to limit the throat disease, as thus is prevented the spread of the local condition to the larynx, to the sub-maxillary glands, and to the Eustachian tubes. He recommends for this insufflation of sodium sozoiodolicum with sulphur, this to be done hourly day and night until the ulcers are clearing up. He keeps his patients in bed for four weeks, and gives whiskey the first few days to prevent cardiac syncope; after the fourth day his patients are given milk only, and nitrogenous foods are especially avoided.

The Local Treatment of Follicular Tonsillitis by the Use of Aspirin.—FETTEROLF (*Therap. Gaz.*, 1908, xi, 761) has used aspirin locally in the treatment of a large number of cases of follicular tonsillitis with very good results. After the mucus has been removed by a solution of sodium bicarbonate, finely pulverized aspirin is applied to the tonsil by means of a cotton swab. Care should be taken not to allow any of the aspirin to reach the larynx, since it may cause severe paroxysms of coughing. The aspirin should be applied to the apparently sound tonsil as well as to the inflamed one if the process seems to be unilateral. Ordinarily three applications at twelve-hour intervals will produce a fall in the temperature and a marked improvement in the local inflammation. Fetterolf thinks the local application of aspirin is also of diagnostic value, for if no improvement is apparent after the second application, the infection is probably not rheumatic.

The Urinary Findings in a Series of Infants Suffering from Intestinal Infection.—J. H. M. KNOX and J. C. MEAKINS (*Arch. Int. Med.*, 1908, ii, 241) have analyzed the urinary findings in a series of infants under constant observation in hospital wards because of diarrhoeal affections, to note the extent and frequency of renal complications in intestinal diseases. In 22 the urine was abnormal; it contained albumin and occasionally hyaline casts as the only pathological element in 7 instances (febrile or toxic albuminuria); in 7 others the presence of pus cells was the chief characteristic (pyuria-pyelitis); in the remaining 8 cases albumin, casts, and pus were all present, indicative of nephritis or pyelonephritis. The urinary changes were more frequent in ileocolitis, than in dyspeptic or fermental diarrhoea, though the extent of renal involvement seemed to depend less on the variety of the intestinal infection and more on its intensity. The pyuria persisted in some instances without apparently interfering with convalescence; in others it yielded to urotropin, and in still others it developed into a serious and fatal complication. The infection seemed to have its origin in the intestinal canal,

whence it reached the kidney either through the blood or lymph-streams, or by contiguity of structure. There was no evidence of involvement of the urethra or bladder or of ascending infection. The few autopsies made indicated clearly that although the kidneys frequently escape injury during enteritis, they become the seat of extensive secondary changes in this as in other forms of infection. The renal changes during intestinal diseases in infections seemed to be those of degeneration (parenchymatous, hyaline, and fatty) of the convoluted tubules rather than those of focal infection. In 19 cases suffering from ailments other than intestinal infection, and for the most part less acute in character, no urinary abnormalities were discovered.

Laryngitis Stridula.—R. RAHNER (*Münch. med. Woch.*, 1908, iv, 2139) had the opportunity of making careful laryngoscopic examinations in three children who had croup (*laryngismus stridulus*), a condition for which a number of explanations have been forthcoming. In all three patients he noted subglottic œdema. The next night he noticed a lessening of the swelling, and with it a decrease of the croupy cough, etc. The third night two of the patients again had more subglottic œdema, and two hours later the bellowing cough and other symptoms returned in their original intensity; the third patient, however, had no attack at all, the œdema having almost completely disappeared. Rahner feels justified in explaining the croup symptoms on this basis, but has no explanation why these attacks always come on at night.

OBSTETRICS.

UNDER THE CHARGE OF

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The Prognosis and Treatment of Puerperal Septic Infection.—HENKEL (*Zentrbl. f. Gyn.*, 1908, No. 42) considers it of the greatest importance in prognosis that the sort of germ causing the infection be recognized. Streptococci are often found in the secretions of the uterus without causing danger. When, however, they are recognized in the blood, prognosis is much more unfavorable, and the infection much more severe in proportion as the hemolytic condition is serious. When cultures upon agar during the first twenty-four hours yield abundant growth of streptococci with hemolysis, the prognosis is considered absolutely hopeless. Streptococci are often found in the urine of septic patients, and while cystitis does not invariably result it frequently does. As regards the general symptoms and prognosis, rapid pulse and high temperature are always unfavorable. In the local examination of such patients gloves must always be used, and care taken to avoid any wound, however slight, of the mucous membrane. Such wounds may introduce germs into the lymphatics and increase the patient's danger. Wounds

occurring during labor are also dangerous in proportion as they are made early; the longer labor continues the greater the danger. A very important factor in the prognosis of puerperal infection is the involution of the uterus; if this proceeds well prognosis is favorable. So far as treatment is concerned, it should be directed to reinforcing in every way the natural methods of resistance. When pieces of the membranes are retained, this in itself is not sufficient to justify dilatation and curetting. The only intra-uterine interference practised is a very gentle but copious douche given with a glass cannula, followed by packing the uterus with gauze soaked in quinine and alcohol. After decomposed amniotic liquid has been expelled this tampon is allowed to remain for not more than twelve hours. When the infection has spread beyond the uterus and is severe, it is well to extirpate the uterus through the vagina. So far as the use of serum was concerned the results were negative. Col-largol also gave no good result. In puerperal pyemia, ligation of the veins of the broad ligament is the only operative procedure promising improvement. This should be done so soon as the diagnosis can be made. When the enlarged veins can be felt at the side of the uterus operation is indicated.

Sacral Anesthesia.—STOECKEL (*Zentrbl. f. Gyn.* No. 1, 1909) draws attention to the value of sacral anesthesia. The patient is placed upon the left side with the lower extremities strongly flexed. The upper thigh is brought up to the abdominal wall. The index finger of the left hand marks the sacral hiatus, and in the fatty tissues the borders of this cleft may be marked with a sterile pencil. With the right hand a needle is introduced through the skin and carried slowly through the membrane into the canal. But little practice is required to make the injection accurately. If the needle passes into the periosteum it can readily be withdrawn and proper direction obtained. The injection is made slowly. If the skin becomes distended a false passage has been made and the fluid is being injected beneath the skin. The needle must be withdrawn and introduced again. But little, if any, hemorrhage accompanies the injection. There is very little pain if the injections are made with aseptic instruments under antiseptic precautions. The length of the needle varies from 2.6 cm. to 4.5 cm. The fluids injected are salt solution, novocain solution of varying strength, with and without adrenalin or suprarenin, eucaine and beta solution with or without suprarenin. The smallest quantity used was 3 c.c. and the largest 83 c.c., while the average was from 30 to 35 c.c. This injection was used in 141 cases, 89 primiparæ, 52 multiparæ. These were normal parturitions without complications. In 139 cases one injection was made, in 2 the injection was repeated. In 96 patients the injection was made during the period of dilatation. In 45 during the expulsive period. In 72 patients pains in the back were entirely removed by the injection. Pain in the back and abdomen as well yielded to injection in 39 cases; 23 patients complained of a sensation of fulness and tension about the anus, probably resulting from the irritation of a coccygeal nerve. In 9 cases the extrusion of the head was absolutely painless; in 16 cases very little pain was felt. Patients seemed to suffer far less and to be much more manageable after the injections. In 3 cases the

head was finally delivered with forceps, and in two a tear in the perineum was closed without suffering. In 2 cases patients felt so much pain when the forceps was tried that a few drops of chloroform were given in addition. Very evident relaxation of the muscles of the perineum and pelvic floor was observed in 4 cases. Injections began to affect patients in from three to five minutes. The effect persisted in a few cases a few moments only, and in some as long as six hours. When injections were made early in labor, uterine contractions seemed to be lessened in 23 patients. In one case in which pains were just beginning, uterine contractions ceased after the injection and did not return for four days. This suggested the use of this treatment in threatened abortion and premature labor. The action of the abdominal muscles seemed to be somewhat stronger after the injection than without it. In one patient the child's heart sounds became slower than normal, and the head was immediately delivered by an easy forceps application. In the third stage of labor, if atony of the uterus showed a tendency to develop, this was controlled by the addition of suprarenin to the injection. One-hundred of these patients lost less than 500 c.c. of blood; 33 less than 1000 c.c.; 6 more than 1000 c.c.; 2 more than 1500 c.c. The dose of suprarenin must not be too large, or an unfavorable result will be produced. No unfavorable effect upon the children was noticed. In the puerperal period, in one case, pains were experienced in the lumbar region; these disappeared spontaneously. It was interesting to note that retention of urine was not present in any of these cases; the use of the catheter was entirely unnecessary. In one patient 66 c.c. was injected by a false passage, causing phlegmon in the right gluteal region, which finally required incision and drainage. The bacteriological examination of the solution, supposed to be sterile, showed the presence of streptococci. In addition to these researches Stoeckel has tried this method in 5 cases of dysmenorrhœa; pain in the back was controlled, and pain in the abdomen was very much lessened. It seems probable that pain in the back from various causes can be controlled in this manner. An experiment was made by injecting into a patient with healthy kidneys 3 c.c. of weak methylene blue solution into the sacral canal, and then observing the discharge of this fluid into the urine by catheter placed in the bladder. The urine began to be colored within one hour after the injection and the coloring persisted for four days. Anesthetic solutions injected, begin to affect the patient within a few minutes after the injection, the effect disappearing in about an hour. These would indicate that the remedies act locally. The article is fully illustrated, and diagrams showing the course of the various sacral nerves and sacral canal are added.

Pregnancy Complicated by Hydatid Cysts.—BLACKER (*Jour. Obst. and Gyn. Brit. Empire*, November, 1908) reports the case of a patient who had attacks of abdominal pain, and who was supposed to have a fibroid tumor of the uterus; complicated by inflammation and adhesions. She was admitted to the hospital, eight and one-half months pregnant, the foetus living. On vaginal examination the cervix was pushed forward, and a soft round tumor filling Douglas' pouch reached to the level of the cervix. The tumor could not be pushed up out of the pelvis. The patient's general condition was good. As the tumor could not be pushed

out of the pelvis, it was thought impossible for labor to proceed, and the patient was delivered by the Porro operation. No attempt was made to remove the pelvic tumor, which was situated in Douglas' pouch, firmly attached to the surrounding tissues. The child was living and in good condition. The patient had some fever after operation. Most of the stump was removed on the ninth day, when pus was found in the wound just above the stump, and in a few days afterward a portion of the wall of a hydatid cyst appeared, followed by several small cysts. The patient became apparently infected, and her condition was diagnosed as iodoform poisoning through absorption. Hydatid cysts continued to be discharged through the sinus. The patient gradually recovered, but returned to the hospital about three months after operation, when more hydatid membrane was removed with pus. The tumor had evidently been a large hydatid cyst which had suppurated. Under drainage the tumor then discharged completely and the sinus closed. The operation was performed in 1896 at a time when the Porro operation was employed more frequently than at present.

Incarceration of the Pregnant Retroverted Uterus; Rupture and Recovery.—CAMPBELL (*Jour. Obst. and Gyn. Brit. Empire*, December, 1908) was called to see a primiparous woman, four and one-half months pregnant, who had retroversion and flexion. Uterine contraction, pain, and external hemorrhage caused her to send for a physician. On inserting the hand into the vagina, a large opening led into the abdominal cavity, the hand passing between the posterior lip of the cervix behind and the bladder in front. The finger could be passed over the posterior lip and downward into the contracted uterus, which lay completely retroverted in Douglas' pouch. On passing the hand upward above the pelvic brim, the fœtus in the unruptured membranes was found free in the abdominal cavity. The membranes were ruptured, the fœtus, placenta, and membranes rapidly extracted. Large coils of small intestine prolapsed into the vagina. They were replaced and the opening packed with gauze. An external pad of sterile gauze and cotton was then applied. Four days afterward these drains were removed, and the vagina packed with iodoform gauze. The patient during convalescence maintained a semisitting posture in bed. She recovered with considerable tenderness and pain in the lower abdomen for the first week of the puerperal period.

GYNECOLOGY.

UNDER THE CHARGE OF

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Malignant Melanoma of the Vulva.—E. HOLLAND (*Jour. Obst. and Gyn. Brit. Emp.*, 1908, xiv, 309) selects the name malignant melanoma for the melanotic tumors of the vulva which have a malignant nature,

instead of melanotic sarcoma, because frequently they are carcinomatous, Holland found recorded but 37 cases of malignant melanoma of the vulva. The ages varied from thirty-three to eighty years, the decades at which the largest number occurred were the sixth and seventh, an equal number occurring in these two; 73 per cent. were over fifty years. Child-bearing seems to have no influence, an equal number occurring in nulliparæ as in women who have given birth to seventeen children. Of the 37 cases 12 began in the labium majus, 6 in the labium minus, 6 in the labium minus and clitoris, 3 in the clitoris, 1 in the mons veneris, 1 in the urethra, and 8 were extensive over the vulva. The condition of the inguinal glands was mentioned in 31 cases, in 25 of which they were affected. The duration of the disease varied from six to eighteen months in the 24 cases available for study. In 35 cases the tumor was excised, in 26 of which the after history shows 19 deaths. In 4 others recurrence is noted, and in 3 non-recurrence is mentioned, in 1 beyond three years. In 33 cases microscopic examinations were made, the findings being in 26 melanotic sarcoma, in 6 melanocarcinoma, and in 1 the nature was not definitely decided. Holland believes malignant melanoma does not necessarily arise from pigmented moles.

Abscess of Gaertner's Canal.—TATE (*Amer. Jour. Obst.*, 1908, lviii, 841) refers to the paucity of the literature on abscess and other pathological processes in this duct, and then relates a case of abscess of Gaertner's canal that was treated by him. Tate finds no cases reported other than one each by Kelly and Routh.

Malignant Tumors of the Ovaries.—GARDNER and McCLEARY (*Surg., Gyn., and Obst.*, 1908, vii, 669), after a careful study of malignant ovarian tumors, advocate the early removal of all ovarian tumors, because primary carcinoma of the ovary usually begins in a benign growth, and an early operation removes a prolific source of malignancy. Even when the malignant process has made considerable progress there is an excellent opportunity to effect a complete cure. Ovarian tumors, according to Gardner and McCleary, should be removed through an abdominal incision sufficiently long to allow the tumor to escape without breaking the cyst wall, as was advocated by Washington Atlee and now recommended by J. Bland-Sutton.

Enormous Ovarian Cysts.—O. J. FAY (*Surg., Gyn., and Obst.*, 1908, vii, 515) reports a case of enormous ovarian cyst in a woman, aged fifty-four years, the presence of which she had known twenty-one years. She had given birth to five children, the last labor occurring thirteen years previously. Although bedridden during the last year and much emaciated, her weight was 270 pounds and her waist circumference seven feet and three inches. Nausea and vomiting and œdema of the legs were prominent symptoms. During the first ten days of her visit to the hospital the abdomen was tapped three times, 150 pounds of fluid being withdrawn. The cyst, markedly adherent and having four large and several small compartments, was removed. The patient died of pneumonia, which developed a month after the operation.

Ovariectomy during Pregnancy.—C. G. CUMSTON (*Amer. Jour. Obst.*, 1908, lviii, 26) records 5 cases he has treated, and reviews the literature on the subject. Statistics show that 19 per cent. of ovarian tumors complicating pregnancy are dermoid cysts, and that the percentage rate of dermoids among ovarian cystomas is 4. This marked difference, 19 and 4 per cent., is due to the slow development of dermoids and their characteristic tendency to remain in the pelvis, from which they are forced upward by a growing uterus. Not all surgeons will endorse his attitude in performing ovariectomy by the vaginal route, as additional danger of spreading infectious or malignant material from breaking the tumor coats, but manipulations of the uterus are necessarily increased and abortion, consequently, rendered more frequent.

Vaccine and Serum Treatment of Gonorrhœa in Female Children.—BUTLER and LONG (*Jour. Amer. Med. Assoc.*, 1908, li, 1301) treated by the vaccine method 25 female children between the ages of one and one-half and twelve years suffering from gonorrhœa, and 5 children, 1 with the acute and 4 with the chronic form of the disease, with the serum method. In summarizing the results Butler and Long state their belief to be that gonococcus vaccine is more effective in the treatment of gonorrhœal vulvovaginitis in children than are local applications, which, in some instances actually delay recovery. The vaccine treatment is very effective, especially in chronic and subacute varieties of the disease in which rapid improvement is noted. The most effective dosage varies in the same child and in different children. The serum treatment is not recommended.

Etiology of Ectopic Gestation.—C. D. WILLIAMS (*Surg., Gyn., and Obst.*, 1908, vii, 519) offers the following suggestions to be considered in the study of the etiology of ectopic pregnancy: (1) A histological examination of the implicated, as well as the non-implicated, Fallopian tube is of more value than simple clinical observation. (2) Clinical examination of the structures may reveal no evidence of an inflammatory reaction nor of anatomical malformations which, however, are possible of demonstration by microscopic examination. (3) Macroscopic examination may show no adhesions surrounding the Fallopian tubes, whereas, microscopically, the mucosa and muscularis of the same tubes may show the evidences of a preëxistent inflammatory reaction. (4) In all of Williams' specimens evidences of an inflammatory reaction, which had preceded the onset of the ectopic gestation, were demonstrable. The observations of Opitz in a series of 23 cases coincide with those of Williams. (5) Schauta, Küstner, Duhrssen, and others believe that predisposition to a tubal pregnancy depends upon a previous inflammation in the tubes and that in most cases it is due to a gonorrhœal infection. With these conclusions Williams agrees. (6) An infection of the gonococcus of Neisser more than any other kind of infection predisposes to the formation of the false diverticula. A tuberculous process does not produce the ideal conditions for the retention and especially for the development of an ovum in the tube. (7) The inflammatory changes in all cases in which both tubes were removed were shown microscopically to be bilateral, and diverticula were present not only in the tube

which lodged the ovum, but also in the opposite one. (8) From an exhaustive study of the subject and from the analysis of a series of cases Williams believes that the presence of these false mucus-lined channels or diverticula produced by an inflammatory reaction in the tubes is the chief predisposing cause of tubal pregnancy in at least 95 to 98 per cent. of all cases.

Fibromyoma of the Uterus and Anemia.—SCHENCK (*Jour. Amer. Med. Assoc.*, 1908, li, 1395) discusses this subject, insisting that anemia is a potent factor in the production of thrombosis and embolism during convalescence from hysterectomy for fibromyomas. Schenck believes no percentage of hemoglobin should be declared as the minimum for hysterectomy, as in some instances it is very low, and yet hemorrhage that cannot be controlled prevents all efforts to raise it. Believing fibromyomas of the uterus are congenital, Schenck is unwilling to accept the four theories proposed by others to account for the cardiovascular changes in patients having such tumors, which are: (1) Alterations in the vascular system are primary, and the cause of fibroids; (2) the presence of the tumor leads to increased aortic tension and other circulatory disturbances which affect the heart; (3) myoma is not a local affection, but a general disease, with a triad of symptoms consisting of tumors, nervous manifestations, and general vascular disturbance; and (4) a toxin circulates in the blood which causes both the uterine tumor and the heart degenerations.

DISEASES OF THE LARYNX AND CONTIGUOUS STRUCTURES.

UNDER THE CHARGE OF
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Atrophic Rhinitis.—PORCHER (*Jour. South Carolina Med. Assoc.*, December, 1908) states that in the treatment of atrophic rhinitis he administers potassium iodide in large doses, up to 800 and 900 grains a day, unless the scab formation ceases under less dosage. He also cleanses the passages with hydrogen peroxide and then applies Lugol's solution.

Ozena, Atrophic Rhinitis, and Purulent Suppurative Sinusitis.—CURTIS (*Laryngoscope*, December, 1908) reports upon the successful results obtained by injecting the nasal cavity with the lactic acid secreting bacillus of Massol. He claims that this is the best means at our command in combating ozena, accompanied by crust formation, and for the tropical treatment of suppurative disease of the ethmoid cells and of the frontal sinus. Not only does the culture act on the pathogenic bacilli in the nasal and accessory cavities, but the active solution

contains a product which has a pronounced effect upon the vasomotor system of the nose.

Ethmoid Perforation of the Inner Corner of the Eye and Involvement of the Antrum of Highmore.—WELTY (*Jour. Amer. Med. Assoc.*, October 17, 1908) reports a case in a man, aged seventy years, who had always been healthy and had for only two weeks noticed a swelling over the right eye which had increased in size daily; but there had never been any discharge from his nose, and he had a good sense of smell and no odor in the nose. Probe puncture of the antrum brought a large quantity of offensive and cheesy pus. The parts were cleaned out, and careful search made for the bony fistula, but it could not be found at that time. Three weeks later it was found to be posterior and above and on the inner side of the eye. The Killian operation was performed. The antrum of Highmore was found completely filled with polyps, granulation tissue, and cheesy pus, which was very offensive. There had been such extensive destruction of bone that the antrum extended to the median line of the hard palate, and as much of the bone of the hard palate as remained was as thin as paper. Convalescence was rapid.

The Surgical Treatment of Hay Asthma, Spasmodic Coryza, and the Like.—YONGE (*Lancet*, June 13, 1908) and BOURGEOIS (*Progrès méd.*, No. 38, September, 1908) report successes by section of the nasal nerve immediately before its division at the level of the anterior ethmoid foramen.

Diphtheria Bacilli in the Throats of the Apparently Healthy.—MYER SOLIS-COHEN (*Jour. Amer. Med. Assoc.*, January 9, 1909) reports the presence of diphtheria bacilli in the throats of many healthy persons who had been in contact with patients suffering with diphtheria in orphanages, homes, public schools, and private dwellings. He contends that cultures from the throats of all the inmates of the house where diphtheria exists should be examined to determine whether they are carriers of the contagion or not. He is of the opinion that despite the rigid disinfection of the houses and their contents, little progress need be expected in the prophylaxis of diphtheria so long as the animate carriers of contagion are neglected.

Intracranial Lesions Consecutive to Nasal and Accessory Sinus Infections.—COAKLEY (*Jour. Amer. Med. Assoc.*, January 9, 1909) succinctly discusses meningitis, epidural abscess, sinus thrombosis, and brain abscess, consecutive to nasal and accessory sinus infection, and describes what is known as the ethmoid route as the most satisfactory technique in exploring the sinuses when operation is indicated.

Osteochondroma of the Septum Narium.—MYLES (*Laryngoscope*, December, 1908) reports a case of osteochondroma of the septum, with extensive absorption of the cribriform plate. The tumor extruded into the cranial cavity and into the sphenoid and ethmoid cells. This was in a man who had had an operation performed upon his nose

ten years previously. Under cocaine and morphine-hyoscyamin anesthesia the growth was removed by external access after one external carotid artery had been tied, and a temporary ligature had been placed upon the other. It was found that prolongations of the tumor had extended into the sphenoid and ethmoid cells and into the orbital and cranial cavities. The patient made an uneventful recovery.

DERMATOLOGY.

UNDER THE CHARGE OF

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The Etiology of Lupus Erythematosus.—SENGER (*Dermat. Zentralbl.*, July, 1908), having found by previous experiments that an ointment of old tuberculin, 1 to 10 or 20 of vaseline, when placed in contact with lupus or other tuberculous dermatoses, produced specific inflammatory reaction comparable with the von Pirquet and conjunctival reactions, has tried the same procedure with erythematous lupus. He claims to have obtained a positive reaction by placing such an ointment in contact with patches of erythematous lupus; and concludes accordingly that this affection is tuberculous.

The Cutaneous Symptoms of Human Trypanosomiasis.—DARRÉ (*Ann. de dermat. et de syphil.*, No. 12, 1908) describes at length the symptoms of trypanosomiasis as manifest upon the skin, basing his description upon the study of twenty cases of sleeping sickness observed in Europeans. Among the early symptoms of this affection the cutaneous manifestations occupy an important place, having, on account of their frequency and their special aspect, great diagnostic value. In some cases the bite of the tse-tse fly is followed by a more or less sharp inflammatory reaction. Some hours after the bite, in one or more points upon the skin, redness and swelling appear accompanied generally by a sensation of burning or, at times by real pain. The next day a little tumor appears, or a red, violaceous, rounded spot a little elevated above the surrounding skin the size of a franc piece. These lesions, occupying the sites of bites, are found upon the nape of the neck, the legs, the knees, the flanks, the axillary region, and are always accompanied by painful swelling of the neighboring lymphatic glands. Darré believes they are the result of the introduction of some irritating substance into the skin, secreted by the fly, or of inoculation of some of the ordinary organisms, such as the staphylococcus. These lesions, while not actually exceptional, are quite infrequent. In the fully developed disease two types of eruption are observed: vesicopapules

accompanied by itching, and nonpruritic, polymorphous, urticaria-like erythemas; these two varieties may co-exist. Pruritus is a frequent symptom, and following it a papulovesicular eruption appears, which consists of small deep-red papules having small vesicles upon their summits.

The polymorphous erythemas are very frequent, Darré having noted them in 12 out of 20 cases under his observation. They occur in all stages of the disease, and are sometimes present very early. Their morphology varies, the erythema sometimes occurring in sheets, sometimes in rings, the latter being the more frequent. The seat of predilection is the trunk, especially the back, although they are likewise seen upon other parts of the body. Their evolution is variable; at times they are transient and recurring, but more frequently they last for weeks and months, varying in intensity, but never disappearing except under the influence of proper treatment. These erythemas are by no means characteristic, and their diagnosis would be very difficult if one did not know that the patient had come from a region in which sleeping sickness was prevalent. In every case the clinical diagnosis ought to be confirmed by a microbiological examination. Microscopic examination of the blood obtained at the site of the eruption by means of very superficial scarification will sometimes give positive results. The treatment consists in the employment of hypodermatic or intramuscular injections of atoxyl, giving 0.50 gram every five days.

The Nature and Treatment of Eczema with Leg Ulcer.—FRANCKE (*Archiv. f. Dermat. und Syph.*, 1909, xciii, Heft 1 and 2) advances the novel view that eczema is an infection having its origin upon the genitalia, with a primary, secondary, and tertiary stage. As the first symptom he finds small vesicles situated upon the glans penis, the inner surface of the prepuce, and in women, upon the vulva, together with some red points in the neighborhood which are accompanied by marked itching. Later the skin of the genitalia shows an eruption consisting of redness, papules, and vesicles. The last stage of the affection consists of an eczema involving all parts of the body, especially the hands and feet, and ulcer of the legs. Francke would place eczema in the same category with gonorrhoea, soft chancre, and syphilis, and believes that, like these, it is contracted in sexual intercourse. As to the treatment, he regards creosote internally as the remedy *par excellence*. With the appearance of itching upon the genitalia he applies compresses to the parts wet with a solution of resorcin 5 to 200. When the eczema has spread to other parts of the body, especially the hands and feet, baths of hot water containing 2 to 5 grams of creosote to a liter and a half are to be employed. Under this internal and external treatment improvement takes place in a few days; the baths are applied less frequently and are eventually replaced by a 10 per cent. resorcin paste. [Francke's view concerning the infectious nature and sexual origin of eczema are hardly to be taken seriously since they are not supported by the clinical facts. His statement that the genitalia are the most frequent site of eczema does not agree with the experience of the majority of dermatologists.—M. B. H.]

PATHOLOGY AND BACTERIOLOGY.

UNDER THE CHARGE OF

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Demonstration of Tubercle Bacilli in the Sputum.—In a comparative study of the different methods of demonstrating tubercle bacilli in the sputum, ELLERMANN and ERLANDSEN (*Zeitschr. f. Hygiene u. Infektionskrankh.*, 1908, lxi, 219) claim that their "double method" is the best for detecting the bacilli in cases in which they are difficult to find. This is a combination of two methods of reducing the sputum to a more suitable form for examination, one depending on bacterial action and autodigestion by the pus cells (so-called "autodigestion method"), the other on the solvent effect of sodium hydrate. The technique is as follows: (1) 10 to 15 c.c. of the sputum to be examined is mixed with one-half its volume of 0.6 per cent. solution of Na_2CO_3 , and kept in the thermostat for twenty-four hours at 37°C . (2) Most of the supernatant fluid is poured off, the precipitate centrifuged, and the remaining fluid poured off. (3) Four volumes of 0.25 per cent. NaOH is added to one volume of the precipitate, carefully stirred, and boiled. (4) The mixture is centrifuged and the sediment examined in the usual way for tubercle bacilli. For less complicated procedures in laboratories, where many examinations have to be made daily, the authors recommend the autodigestion method, represented by steps one and two of the above description, or Hempel's simpler method, which merely consists in heating the sputum for four to eight minutes in a waterbath at 65° to 75°C ., to break up the mucus, then centrifuging and making the smear from the sediment.

Typhoid Bacilli in Stomach Contents Containing Bile.—Utilizing a contribution of Volhard, who showed that after ingestion of 200 c.c. of oil, bile appeared in the stomach, WEBER (*Münch. med. Woch.*, 1908, ly, 2443) investigated the stomach contents of patients who had typhoid or paratyphoid bacilli in the stools. He found that half an hour after taking the oil, bacilli were present in large numbers in the stomach contents of two cases of typhoid and one of the paratyphoid bacillus carriers. At the same time the stools showed very much fewer bacilli. The organisms were isolated also from stomach contents that had stood twenty-days at room temperature. The author suggests that this may be an easier and surer method of discovering bacillus carriers, especially as Kayser has shown that the investigation of the stools is uncertain and that bacilli may reappear at intervals after being absent for some time. This method may be of use also in testing patients before leaving the hospital, to find out if they still harbor the organisms in their gall

bladders. A disadvantage is that the bile does not always occur in the stomach contents after such a procedure, and then the stomach contents is free from bacilli. The test has not as yet been used extensively.

Reflex Cardiac Arrhythmia.—KOBLANCK and ROEDER (*Arch. f. d. ges. Physiol.*, 1908, cxxv, 377) have undertaken experimental investigation of a phenomenon observed clinically and reported upon (*Deut. med. Woch.*, 1908, No. 24) by one of the authors, who studied a case of cardiac arrhythmia which was apparently due to changes in the nasal mucous membrane. Eight cases of cardiac arrhythmia were subsequently cured by electrolysis of the nasal mucosa. Although the myogenic theory of the heart beat is well grounded, the nervous system plays an important regulatory role, and it is often difficult to determine which of the regulatory factors is at fault in given cases of arrhythmia. The authors add to the numbers of factors already considered responsible for cardiac arrhythmia a swelling or irritation of a certain region of the nasal mucous membrane. In a series of experiments they stimulated the nasal mucosa mechanically and chemically in dogs and rabbits while arterial pulse curves were taken. They found a definite spot in the nasal mucosa high up on the septum, the stimulation of which was followed by a definite, well-marked arrhythmia. Various other points in the nose, and points in other parts of the body were stimulated without producing any effect on the heart rhythm, but the authors do not believe that the "Herzstelle" in the nose which they describe is the only point where reflex disturbance of the heart rhythm may be produced, but that this is the point of predilection. Arrhythmia was produced in a dog and in a man during a "nose-bleed," which ceased when the nose was freed from the blood that rested between the middle turbinate and the "Herzstelle," and adrenalin was found to stop the "nose-bleed" and cure the arrhythmia at the same time. This drug effected arrhythmia due to swelling of the mucous membrane of the nose, and electrolysis of the spot resulted in a disappearance of the arrhythmia. The nervous path from the nose to the heart was investigated by stimulation after cutting the vagus and the second branch of the nasal trigeminus, and the authors conclude that the vagus is not the only path by which this reflex travels. The reflex is, however, absent after the second branch of the trigeminus is cut. The arrhythmia was observed in the exposed heart in which both the auricles and the ventricles were seen to be affected by this form of arrhythmia.

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ORIGINAL ARTICLES.

**THE DIAGNOSIS OF GASTRIC ULCER AS TESTED BY
OPERATION.**

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I REPORT herewith a study of fifty consecutive cases of gastric, pyloric, and duodenal ulcer, in which the diagnosis was placed beyond all doubt by the findings at operation. I might have collected many more personal cases, had I included the much larger number not coming to operation in which the diagnosis was still reasonably clear, but this would have introduced doubt as to the real condition. A number of hospital cases, which were equally well verified by autopsy, are omitted for lack of sufficiently clear histories. My records are less complete than they should be, but many of the cases were seen but once or twice before operation. The patients were all operated upon by nine of our Colorado surgeons.

Twenty-eight of the patients were males, twenty-two females. There were twenty-one in the fourth decade, twelve in the third, nine in the fifth, six in the sixth, and two in the second. Twenty-eight of the ulcers were active at the time of operation; twenty-two were healed, but had led to symptoms demanding operation because of contraction of the cicatrix, formation of adhesions, etc.

In eleven cases there had been trouble for from eighteen to thirty years. In five of the cases the ulcers were still active. Nine had existed ten to fifteen years, five for five to ten years, seven for three

to five years, eight for two years, and ten for one year or less. Thirty-three of the ulcers were (or had been) pyloric, thirteen were definitely gastric, and four definitely duodenal. Case sixteen had a scar of a healed ulcer in the pylorus and an active ulcer two inches above. Case twenty-six had an old scar at the pylorus and a similar one below it. Of the thirty-three pyloric ulcers, eighteen were still active.

In thirty instances the stomach was dilated, fourteen being from active ulcers and sixteen from scars of healed ulcers. In many of the cases adhesions were in part responsible for the obstruction. In but one of the four definitely duodenal cases was dilatation noted. In twenty-six of these dilated stomachs splashing was noted.

I have studied these cases expressly to bring out the relative frequency and value of the different symptoms and signs of ulcer, for I believe the diagnosis is not made in many cases justifying it, much to the detriment of the patient.

Of the fifty cases, thirty-three had had vomiting (66 per cent.); seventeen had not. Seventeen had had hematemesis (34 per cent.) and four had passed blood by the bowel (8 per cent.). Forty had had sour stomach to a notable degree (80 per cent.). Forty-one had had notable pain (82 per cent.), and, when examined, thirty-five (70 per cent.) had tenderness, and thirty (60 per cent.) muscular rigidity in the region of the stomach. Thirty-seven (74 per cent.) had lost from ten to fifty-five pounds in weight.

Records of the chemical analysis of the stomach contents are available in but thirty-six of the cases. Several demanded instant operation, others were seen but once in consultation, and in others, various reasons prevented a full and careful investigation such as should be made in this important class of cases. Of the sixteen cases of active gastric and pyloric ulcer examined, twelve had high acidity, four were below normal. Seventeen of the cases in which we found a healed ulcer were examined chemically, and fifteen were below normal in acidity. In case fifteen, with hyperacidity, the healed ulcer was apparently of no moment, and the real cause of the obstruction was a Treitz's hernia, the duodenum being completely blocked, as it had doubtless been many times before, in the opinion of Dr. Freeman and myself. In only two cases of duodenal ulcer was gastric analysis available; a low acidity existed in one of these, hyperacidity in the other. Several of the cases found by me to have a low acidity had previously had hyperacidity.

In many cases tenderness over the lower ribs, generally on the left, was noted, and in others great hyperesthesia over the immediate seat of the ulcer. Rigidity is present in so many cases that we must account for it otherwise than as the result of an active ulcer. The adhesions seen so generally about a healed ulcer are, I believe, a sufficient explanation.

Case eighteen had the scar of an old ulcer adherent to the liver; case thirty-eight a scar adherent to the pancreas, and cases four, thirty-two and forty-five, scars adherent to the gall-bladder. Case nineteen had an hour-glass stomach from distortion produced by the healing of a large ulcer. Case forty-five showed a chronic pancreatitis. Cases six, eight, and eleven were operated on for perforation of a gastric ulcer, and nine for an incomplete perforation near the pylorus, lymph flakes being found upon the peritoneum over the ulcer, with delicate adhesions to the adjacent loop of bowel. In case six the perforation was a large one on the greater curvature, and was seen nearly twenty-four hours after the accident. This was the only fatal case of these four. They were operated upon by Drs. Bagot, Fleming, Freeman, and Perkins.

All but the fatal case (six) just mentioned, and case thirty-two, in which old adhesions to the gall-bladder were broken up, but no dilatation existed, and case forty-eight, were treated by gastro-enterostomy—several times with an additional operation upon the gall-bladder or appendix—except that in two of the cases, Finney's operation was preferred. Case forty-eight had a large cancer developed upon the base of the ulcer. She had about a third of the normal acidity in the stomach contents; an exploration only was made.

There were six fatalities. Case four died of shock following a gastro-enterostomy, in which, owing to old and extensive adhesions, the clamp could not be used; the operation was, therefore, much prolonged, and more blood than usual was lost. Case six failed to recover from the repair of a twenty-four-hour-old perforation. Case thirteen died from shock following a secondary operation for the incarceration of small intestine in a Treitz's hernia, after a gastro-enterostomy had been successfully carried out. Case fourteen died from acid intoxication following the anesthetic. Case twenty-seven, with a greatly dilated stomach from the scar of an old ulcer in the pylorus, was sent to his home eighty miles away, because of chronic lung trouble with myriads of pneumococci in the sputum, which we thought forbade operation, and especially an anesthetic. He came back in a fortnight and said that he preferred the chance of death from pneumonia to his present condition. He died in forty hours from a very virulent, acute pneumonia as we had feared. In case forty-two the duodenum was obstructed by the pressure of the superior mesenteric vessels after the operation, and death occurred from this and from hemorrhage into the stomach.

Of the remaining forty-four cases, thirty-two may be classed as cured, ten as more or less relieved, while one, with a dilated, atonic stomach, is, if anything, worse off than before, and the case with cancer remains as before so far as the operation is concerned.

We have found, as the Mayos have noted, that those patients with the stomach dilated beyond all hope of regaining its motor

power generally fail to improve. Several instances have been observed by those of us interested in this series of cases, in which a simple atonic dilatation was associated with pronounced neurasthenia, and none has been materially improved by operation.

Cases thirty-eight and thirty-nine were brothers, and another brother is reported to have died of perforation of a gastric ulcer. Cases twenty-one and twenty-nine were sisters, both trained nurses, and neither was aware of anything more than a slight indigestion, yet both had healed ulcers blocking the pylorus. Several of the cases of pyloric ulcer had previously been operated upon for supposed gallstones or appendicitis, with negative findings. I think this history is much more common in duodenal than in gastric ulcer.

The idea is widespread that dilatation of the stomach occurs in ulcer only as the direct result of mechanical obstruction. There can be no question that in many cases, in which at operation the pylorus admits a finger freely, there is nevertheless great dilatation of the stomach. The influence of spasm of the pylorus from the irritation of an ulcer in that region, possibly from hyperacidity alone, in the causation of such a dilatation is most important. I believe that surgical intervention is indicated in practically all of these cases, for if the ulcer heals a later dilatation of the stomach, from a contracting scar, will probably call for the surgeon's aid. If they must be operated upon, the earlier the better.

It will be noted that pain, persistent sour stomach, tenderness, vomiting, and rigidity were the most frequent indications of ulcer, occurring respectively in 82, 80, 70, 66, and 60 per cent. of the cases reported. Gastric hemorrhage occurred in but 34 per cent., and bloody stools in but 8 per cent. Curiously no one of the four definitely duodenal ulcers gave a history of hemorrhage of any kind.¹

In case forty the patient came to me for hiccough coming on at intervals over a period of eleven years, and existing for a week or two at a time with great severity. I found a history of hematemesis, vomiting, and sour stomach, with pain, tenderness, rigidity, and high gastric acidity. I recommended gastro-enterostomy for the supposed ulcer as a cure for this hiccough, which was alarming at times. Dr. I. B. Perkins operated upon him with complete success, the stomach symptoms and the hiccough remaining absent to the present writing—eleven months after operation. The lesion was a saddle ulcer near the pylorus.

In one of these cases, and one other recently seen, a small hernia was present in or near the linea alba, and contributed much toward the discomfort complained of. In each case acute pain was caused by pressure upon it, and complete relief was obtained by operation

¹ Since closing this series of cases, I have seen one such case fatal from repeated hemorrhages after gastro-enterostomy was done.

directed toward cure of the hernia and the simultaneous correction of the pyloric obstruction in the one already operated upon.

The frequent finding at operation of enlarged lymph nodes should be noted as well as the chance of error in basing a diagnosis of cancer upon their presence, with an associated thickening about the pylorus. I have seen a tumor at the pylorus the size of an egg disappear with the healing of an ulcer in this region.

I find myself frequently unable to distinguish between pyloric and duodenal ulcers, while those situated above the outlet may generally be diagnosticated as being so placed from the absence of obstructive symptoms, and frequently from local, acute tenderness to the left of the pylorus. The tenderness is certainly more marked in ulcers on the anterior surface of the stomach than elsewhere, in my experience. I agree with Graham's statement, that pain is relieved for a longer time after eating in duodenal and pyloric ulcers than in those above the pylorus.

In these fifty cases there were but two errors in diagnosis, excepting as to the exact location of the ulcer, a point of minor importance. In case thirteen, owing to persistent sour stomach for a whole summer ten years ago, with acute symptoms and high acidity of recent origin, I diagnosticated an old healed ulcer with a recent acute one, or else an active one which had never entirely healed in all this time. We found a scar of a healed ulcer two inches long on the greater curvature, and Treitz's hernia already mentioned, which accounted for the acute symptoms.

In another case my diagnosis was very positively in favor of cystic gallstones, but it proved to be duodenal ulcer. With the same symptoms and absence of hemorrhage, I fear I should repeat the mistake in a similar case. No permission to give a test meal could be obtained in this instance. I have made the same or a reversed error before. I should state, however, that seven or eight of my patients were operated upon while I was collecting this series, in which, from its known frequency as a cause, scar of a healed gastric ulcer was erroneously diagnosticated as the origin of a dilated stomach, when this was really purely atonic or due to adhesions from old gall-bladder disease, spasm from irritation of a concretion in the appendix, kink from a floating right kidney, from a prolapsed colon dragging on the stomach, or other near-by disease.

If I were entitled to make any criticism upon our usual attitude toward the diagnosis of gastric ulcer, I should say that we are, first, inclined to look upon the disease as a comparatively rare one instead of a very common one; second, that we are inclined to look for a too classical history, especially of vomiting and hematemesis, with a high acidity reported from the laboratory; third, we are inclined to place altogether too much reliance upon the chemical findings and too little upon the results of the physical examination, and are therefore making far too many diagnoses of hyperacidity when the finding

by careful examination of the slightest unilateral rigidity in the epigastric region, associated with local tenderness, should lead us to diagnose ulcer instead.

The chemical evidence is so extremely variable, that we should not let it overweigh the more reliable findings of the bedside examination. After a chronic gastritis is set up, or a marked dilatation from obstruction occurs, or the patient becomes anemic, the hyperchlorhydria often disappears, and its absence should not count against the diagnosis of ulcer. Rather than to look too narrowly for exactly this or that evidence, we should take the broader ground that ulcer probably exists in most patients complaining of persistent indigestion, even though not of an acid character, if pain, tenderness, vomiting, and rigidity, or two or three of these phenomena be present, and even though hyperacidity be not proved. Most of us incline to wait for too positive and classical a picture before making the diagnosis, as is so often the case with the diagnosis of pulmonary tuberculosis and other common diseases.

It will be noted that the errors mentioned have been rather on the side of diagnosing ulcer when the dilated stomach, which really led to the diagnosis, was caused by some other condition. Yet no harm comes from this error since the dilatation often calls for operation, while a failure to diagnose ulcer, because, perhaps, the evidence is not conclusive, leaves the patient exposed to still further dilatation of the stomach, to hemorrhage or perforation, to neurasthenia from imperfect nutrition, and other ills that follow chronic ulcer. Our patients will be better off if we lean a little too much to the side of ulcer, and too little to that of simple hyperacidity.

I think there can be no question that ulcer of the stomach is much more frequent than we generally believe; that a scar may be frequently found blocking the pylorus in those in whom no symptoms have pointed toward ulcer, so far as an intelligent patient can inform us; that ulcer is probably present in the majority of cases of persistent sour stomach; that the finding of tenderness and rigidity over the stomach in the latter class of cases should be regarded as practically clinching the diagnosis, except in certain neurotic individuals; that a markedly dilated stomach in a young patient, not especially neurasthenic, should raise a presumption of pyloric ulcer or its results, if there have been any symptoms of indigestion in the past; that no neurasthenic should be treated without first investigating the size and digestive power of his stomach, regardless of the presence or absence of a history of ulcer; that patients not helped promptly by medical treatment should be studied carefully from a surgical standpoint; that the bedside examination must be given much greater weight in the diagnosis than the report from the laboratory; and that the diagnosis of ulcer may be made with very reasonable certainty if a careful investigation be carried out.

THE DIET IN TYPHOID FEVER.¹

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IN the absence of specific therapy, the importance of diet cannot be overestimated. This fact was keenly appreciated by the old masters in medicine: a casual historical retrospect shows the fever-besieged patient stimulated to the utmost with medicine and food, or subjected to the mercies of depleting drugs, venesection, and starvation, according to the prevailing dicta of the day. As physicians began to classify diseases, treatment, including diet, became more rational; but until the laboratories contributed their share to our knowledge of the functions of the body in health and disease, dietary rules were mainly empiric. Graves "fed fevers" because he saw excellent results from feeding. At present the clinician is influenced by the knowledge which results from scientific activity in the laboratories; he not only knows the exact anatomical changes produced by the disease he is treating, but he also has at his command an ever-increasing fund of facts relating to disturbances of function or to the complex problems of the chemistry of the body. Normal metabolism is in general understood, and much light has been thrown on the more difficult question of metabolism in disease. The conclusions from laboratory experiments are made doubly valuable or are nullified for practical purposes by a careful application of results at the bedside, and the spirit of modern medicine demands such a correlation.

This relation between the laboratory and the ward—the science and the art—has been especially prominent in the more recent studies on typhoid fever. In this paper I shall bear this point of view in mind as I briefly review the underlying principles of nutrition in typhoid fever, the conclusions drawn from the application of these principles to experimental studies, and finally the results of testing these conclusions at the bedside.

Various as are the manifestations of typhoid fever, there is yet one feature common to all cases: the course of the illness is a long-drawn-out battle between the patient and the disease. Since in all battles the strength of the combatants is to be preserved, this rule of more actual warfare is adopted in medicine to the conflict with such diseases as tuberculosis and septicemia. Starvation is in itself a disease with various symptoms due to disturbed metabolic processes, and if Ewing's² work is correct most of the symptoms of

¹ Read at the Semi-annual Meeting of the Southwest Virginia Medical Society, Bristol, Virginia, December 3 and 4, 1908.

² Nitrogen metabolism in Typhoid Fever. *Med. Record*, March 30, 1907, p. 537.

typhoid fever are caused by somewhat similar metabolic changes. Leaving for later consideration certain specific theoretical and practical objections to this statement and accepting as true the broad comparison, it becomes evident that in typhoid fever our therapeutic goal should be the strengthening of our patient to the full limit of good, without harming him. Food at once must be considered the main weapon in our hands, and we should provide a diet with sufficient nutrition while we remember the handicaps under which the patient fights. Milk, which contains all the elements of a proper food in convenient form, has for long been esteemed the ideal diet for such a condition, and yet with patients on the milk diet as ordinarily practised loss of weight has been a striking feature of most cases of the disease. From a large series this loss has been estimated to amount to 200 to 600 grams daily (7 to 20 ounces), made up of water, fat, and the protein of body tissues, the greater part probably coming from the destruction of body tissue. By determining the amount of nitrogen in food, feces, and urine, it is in general easy to learn how much protein is absorbed from the food supply, and how great is the protein loss from the body tissues. In a table of statistics of 178 experiments collected by Nichols,³ it is well shown that an insufficient supply of food nitrogen results in poor absorption and extensive nitrogen loss, while with a more liberal supply of nitrogen (16 to 20 grams) about 88 per cent. is absorbed, and the nitrogen loss is reduced to a minimum of 3.7 grams per day. Practically this means that starvation is the greatest cause of the loss of body weight, and that sufficient food would prevent to a great extent the loss of weight.

Exactly how much of the emaciation is due to the pyrexia or to the toxemia or to both is difficult to estimate, although it is known that by artificially raising the body temperature an increase of protein metabolism does occur. On the other hand, it has also been shown both in laboratory and bedside experiments that an increase in the diet will decrease protein destruction even in fever, and the opinion of most investigators is that a more liberal diet prevents to a great extent the protein loss due to fever as well as that due to starvation.

That the ordinary typhoid-fever diet does not prevent this emaciation is evident, and the reason is clear. A normal resting individual weighing 70 kilos (150 pounds) and receiving sufficient food expends about 33 calories per kilo of body weight per day, or a total of 2300 calories. In fever there is approximately an increased heat production of 25 per cent., which added to the 2300 calories makes 2800 calories. If a fever patient does not have this amount of energy supplied in his food he will burn up his own tissues to supply the deficit. If he receives 1500 to 2000 c.c. of milk per day, as in the ordinary milk diet, he receives about 1000 to 1400 calories only. The

³ Diet in Typhoid Fever. Fiske Fund Prize Dissertation No. 50, Providence, 1907 (contains complete bibliography).

liquid diet, of which milk is always the main constituent, has about the same caloric value. If all typhoid subjects were to get 3 to 4 liters of milk daily the problem of typhoid-fever feeding would be simple, but for many very obvious reasons this is impossible, and we must look for additional food to supply the deficiency.

It is almost a traditional belief in medicine that milk and other liquids are the most easily digested and absorbed, as well as the least likely to excite harmful peristalsis in the inflamed intestine, but there is certainly not sufficient evidence to prove this assertion. As a matter of fact, experiments performed on typhoid fever patients during the febrile period of the disease show that the absorption of most easily digested foods, including milk, is on the average 5 to 10 per cent. less than in a normal person. Further, excluding foods with a heavy vegetable residue it is impossible to prove that food, such as an egg or a piece of meat, will reach the inflamed Peyer's patches in more solid form than milk which enters the cardiac orifice of the stomach a liquid and leaves the pylorus a solid.

But, after all, the proof of the typhoid diet is in the eating, and we must look to actual results of various diets for the final test. Barrs,⁴ in 1897, wrote about a less restricted diet that "it is likely to modify favorably the death rate, to shorten convalescence, to diminish the risks of complications and sequelæ, and to make typhoid fever a less formidable and more manageable disease than it is under our present standard methods of treatment." Before and since that time observations have been made by clinicians in various countries with diets varying from the mere addition of soft eggs or soft toast to one containing meat, and as far as I have been able to determine not a single adverse report has come from any observer who has had the courage to try a more liberal diet. In this country Shattuck⁵ was the first to point out the advantages of a more liberal diet, and Thayer,⁶ by calling attention to the excellent results obtained by certain Russian investigators, stimulated further active interest in the subject. Litchfield⁷ also has recently written on the subject. Kinnicutt⁸ collected the available statistics up to 1906, with the results seen in Table I.

TABLE I.

No. of cases.	Relapses.	Per cent.	Hemor-rhages.	Per cent.	Perfora-tions.	Per cent.	Deaths.	Per cent.	
733	48	11.3	35	4.7	10	1.3	60	9.4	Liberal diet.
4654	507	10.8	411	8.8	111	2.4	491	10.5	Liquid diet.

⁴ A Plea for a Less Restricted Diet in Typhoid Fever. Brit. Med. Jour., 1897, i, 125.

⁵ Diet in Typhoid Fever. Jour. Amer. Med. Assoc., July 10, 1897, p. 51.

⁶ Progressive Medicine, 1899.

⁷ Nourishment of Patients during Typhoid. Penna. Med. Jour., October, 1908.

⁸ Principles of Feeding in Typhoid and in other Fevers. Boston Med. and Surg. Jour., clv, i, 1.

It is seen that the death rate is lower, there are fewer perforations and hemorrhages, and a slight increase in relapses in those cases liberally fed.

An analysis of the cases treated at the Johns Hopkins Hospital from July, 1906, to July, 1908, inclusive, to which I am allowed to refer by the courtesy of Professors Barker and Thayer, shows the following results (Table II).

TABLE II.

	No. of cases.	Hemorrhages, per cent.	Perforations, per cent.	Relapses, per cent.	Abdominal pain, per cent.	Nausea, vomiting, per cent.	Distention, per cent.	Hypothermia, per cent.	Tachycardia, per cent.	Deaths, per cent.
Series I. Liberal diet.	98	13.3	3.0	18.3	26.5	15.3	7.0	44.3	51.1	6.1
Series II. Liquid diet.	149	16.7	3.3	12.7	30.8	17.4	9.4	53.1	42.0	12.7

The 149 cases in Series II include about 75 who received only milk and albumin water, approximately from 700 to 1000 c.c. of each daily, a few extremely ill cases who received albumin water only, and about 70 who had broths in addition. The 98 cases of the first series include all patients who were given, during the febrile period, any soft or semisolid food—some received simply one soft egg three times a day in addition to liquids, others got also soft toast, but most were allowed the choice of eggs, toast, thin gruels, custard, junket, and jelly. There was no rule of selection of cases, but patients who were extremely intoxicated on entering the hospital generally would not take more than liquids. This probably means that, on the whole, the fed cases were slightly milder than those of Series I. Both series include cases from all seasons of the year, the patients were from the same walks of life, and were given identical treatment except for the diet. In all cases water was freely given. Both tables show that there is no justification for the fear felt by some about the possible increase of complications following more food, and with the exception of the increase in relapses the results are all in favor of a freer diet. In the Johns Hopkins cases the deaths in Series I were due in three instances to perforation, in two to toxemia, in one to hemorrhages; one patient was in the hospital only two days before the exitus. To avoid unfair comparisons the deaths in Series II must be explained. Six patients were in the hospital from one to six days before dying: one from acute nephritis, one from typhoid meningitis associated with general peritonitis due to a gangrenous appendix, four from the extreme toxemia. Further, one death was due to intestinal strangulation caused by adhesions from an old gynecological operation. Of the 12 remaining, 4 died from

perforation, 1 from a scrotal abscess, 1 from pneumothorax, and 6 from the effects of the toxemia. Therefore, one is not by any means justified in concluding from these comparative death rates that a more liberal diet lowers the mortality 50 per cent. The incidence of hemorrhage and perforation is less; the rather large difference in the number of relapses was surprising, but the small number of cases may easily account for this. As relating to the digestibility of the respective diets, it is interesting to note that abdominal pain, nausea, vomiting, and distention are present to a less degree in Series I than in Series II. Diarrhœa is such an uncommon feature of typhoid fever at the Johns Hopkins Hospital that notes on its very occasional presence have no value in the present analysis. Hypothermia was distinctly less marked in Series I, not only in percentage values, but also in the degree to which it was present in the individual cases. The increase in the percentage of tachycardia is possibly due to the fact that the patients of Series I were let out of bed earlier.

In order to determine any possible effect of diet on the length of the disease, calculations were made of the average length of pyrexia and of duration of illness. The results are expressed in Table III.

TABLE III.

	Duration of fever.	Duration of illness.	Convalescence.	
Series I. Liberal diet.	34.2	52.4	18.2	} Days.
Series II. Liquid diet.	32.9	53.0	20.1	

Only those patients who recovered were included in this list. The temperature was considered normal only when it was 99° in the rectum for a whole day and remained so. In case of relapse, the first day of normal temperaure following the relapse was used in the calculation. It is seen that in the cases fed the duration of pyrexia was slightly longer, as is to be expected from the increased number of relapses; but the total length of the illness is shorter, and convalescence is almost two days less.

In typhoid fever results may follow certain lines of treatment, not because of the treatment, but rather as co-incidental happenings: consequently, results such as these must be accepted conservatively. Certainly physicians who have treated patients in both ways agree that convalescence is less formidable; that the necessary increase in diet during convalescence is a far easier task; that the patient is much more comfortable; and that his general condition is better after an attack of typhoid during which his dietary is "liberal." Such a liberal diet has been tested sufficiently to warrant the conclusions not only that it is not harmful, but that it offers distinct advantages over the low diet. The distressing hunger and extreme emaciation are

symptoms which can be prevented in most cases; and with care in the selection of food we should not only be able to do this, but we should also be able to stimulate the psychic factor of digestion and thus allow of better absorption than is possible with distasteful food. It still remains for the hospital laboratory to determine the ideal proportions of fat, carbohydrate, and protein in a typhoid-fever diet. Schaffer's⁹ recent work with a high carbohydrate ratio is most suggestive. Although the chemical composition and the caloric value of any food can be found in published tables, for general purposes outside of hospitals it is sufficient to choose a dietary from a wide variety of digestible foods, such as has been used by Shattuck (appended below). No absolute rules can be laid down, and all patients cannot be freely fed. A hospital physician can order articles of diet for his typhoid-fever patients which a country practitioner would find absolutely impracticable. The question is not of a choice of solid or liquid food, but of sufficient food selected so as best to supply the wants of the organism without harming the patient.

The conclusion drawn from this study is, that, while details of diet cannot be prescribed by dogmatic rules, the underlying principle in feeding typhoid fever patients should be to furnish at least the same amount of food energy required by a healthy resting person.

Shattuck's Dietary: Milk, hot or cold, with or without salt, with lime water, soda water, Apollinaris, Vichy; peptogenic or peptonized milk; cream and water; milk with white of egg and slip; buttermilk; koumyss; matzoon; whey; milk with tea, coffee, cocoa.

Soups: Beef, veal, chicken, tomato, oyster, mutton, pea, bean, squash, carefully strained and thickened with rice, arrowroot, flour, milk, egg, cream, barley.

Horlick's, Mellin's, malted milk, carnipectone, bovine, somatose, beef juice.

Gruels: Strained cornmeal, crackers, flour, barley water, toast water, albumin water, lemon water.

Ice cream.

Eggs: Soft boiled, raw, eggnog.

Finely minced lean meat, scraped beef, soft part of raw oysters, soft crackers with milk or broth, soft puddings without raisins; soft toast without crust; blanc mange, wine jelly, apple sauce, macaroni.

⁹ Metabolism in Typhoid. Jour. Amer. Med. Assoc., September 19, 1908, p. 974.

TYPHOID BACILLURIA.

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FOR many years typhoid fever has been known as a disease which occurs with varying frequency, sometimes assuming the proportions of serious epidemics, again becoming rare, but seldom entirely absent from populous regions. With the discovery that the fever is due to a definite and recognizable bacterium, it seemed as though the disease could be checked by measures designed to prevent the dissemination of the organism from the patient. The first measures were taken to prevent dissemination by the feces, in which the bacillus was early discovered. Then it became apparent that through the urine, too, the bacillus is spread, and measures were taken to disinfect this excretion. However, even with the most careful disinfection of all excretions, and vigorous sanitary supervision of water and food supply, cases of typhoid fever continued to develop. Of late, the important observation has been made that a person who has recovered from typhoid fever, or even a person who has never clinically manifested the disease, may carry in his body for months and years virulent typhoid organisms and continue to infect the community. The gall-bladder, the intestinal tract, and the urinary bladder have all been found to harbor the bacilli in great numbers. Additional measures against these foci of infection now occupy the attention of preventive medicine and sanitation. This paper will consider only the occurrence and the control of typhoid bacilli in the urine.

In 1881 Bouchard found in the urine of typhoid fever patients bacilli similar to those discovered the year previous by Eberth in the spleen and mesenteric glands. He examined the urine of sixty-five patients, and demonstrated the bacilli in twenty-one cases. His observations have since been repeated and elaborated by a number of observers. But the present attitude of science toward the occurrence of typhoid bacilli in the urine must be based chiefly on the observations of the past twelve years. The results of even the most careful earlier researches are not reliable, for not until 1896 did the development of the knowledge of serum agglutination and the improvement in bacteriological technique admit of accurate differentiation between the colon and allied groups and the typhoid organism. Therefore, this article deals principally with recent observations.

I have been interested in the occurrence of typhoid bacilli in the urine for some years. When on the house staff of the New York Hospital, in 1902, I studied a series of fifty consecutive cases of

typhoid fever, and found the typhoid bacillus in the urine of eleven cases. Since that time certain laboratory work has been done bearing on the appearance and disappearance of the organism. In this paper I will, first, summarize my own cases; second, discuss the clinical and laboratory observations of the various investigators which bear on the occurrence of typhoid bacilli in the urine, incorporating in this discussion the details of my own work; and, third, consider the treatment of typhoid bacilluria.

SUMMARY OF PERSONAL CASES.¹ At the New York Hospital, from August to December, 1902, 50 consecutive cases of typhoid fever were followed by urine cultures from the time of their admission to the hospital into the third week of convalescence. Cultures were taken every three to six days; in 197 examinations catheterized urine was used; in 126 others the urine was passed by the patients. One cubic centimeter of urine was caught directly from the stream into each of two 10 c.c. tubes of bouillon, and into several empty tubes for observation and analysis. The urine of these 50 cases was also studied by numerous gross and microscopic examinations. Several other cases were followed for periods until proved not to be cases of typhoid fever.

The bacterial findings in the 323 examinations were:

Typhoid bacilli (pure)	47
Typhoid bacilli and cocci	6
Typhoid bacilli and colon	1
Staphylococci	36
Streptococci	11
Diplococci (?)	4
Colon bacilli	7
Proteus	6
Hay bacillus (?)	3
Mixed bacilli	9
Number of times sterile	193

The cocci were largely contaminations from the urethra in cases which had previously had, within two years, a urethritis. In one case streptococci faintly clouded the catheterized urine. This *Streptococcus bacteriuria* was unaccompanied by symptoms and quickly disappeared spontaneously. One case of persistent *Colon bacilluria* was present in a male patient at the first and three subsequent examinations. Otherwise, the colon, the proteus, and the mixed infections were traceable to catheterization, other than the clean catheterizations of this series.

The bacilli tabulated as typhoid were accepted when they grew out actively on the first or second transfer in bouillon, produced no indol, produced no gas in glucose agar, and did not change litmus

¹ I desire to express my indebtedness to Drs. George L. Peabody and Samuel W. Lambert, attending physicians to the New York Hospital, for the use of the clinical material of this series, to Dr. Louis Hamman, former house physician, for suggestions and assistance, and to Drs. William J. Elser and J. C. Roper, for suggestions and for the use of the laboratory of pathology.

milk, and were completely agglutinated within five minutes at a serum dilution of 1 to 50.

TOTAL, FIFTY CASES.

No.	Age.	Sex.	Type.	Eruption.	First culture.	Albumin.
11	12-20	Male, 39	Fatal, 3	Marked, 11	1st week, 16	Heavy, 2
17	21-25	Female, 11	Severe, 14	Moderate, 12	2d week, 22	Moderate, 2
12	26-30		Moderate, 17	Scanty, 20	3d week, 8	Scanty, 31
9	31-40		Mild, 16	No spots, 7	4th week, 4	None, 15
1	45		Relapses, 10			

POSITIVE CASES.

Serial No.	Age.	Sex.	Type.	Eruption.	First culture.	First positive.	Known duration.	Albumin.	Pus.
5	45	Male	Severe	+	17th day	17th day	17th day to 29th day to 59th day	0	+
6	27	Male	Moderate relapse	+	21st day	28th day	28th day to 50th day	+	+
19	21	Male	Severe	++	11th day	27th day	27th day to 41st day	+	0
24	29	Male	Severe relapse	++	14th day	63d day	63d day to 79th day	+	0
28	27	Female	Severe	+	11th day	20th day	20th day to 34th day	+	+
33	14	Male	Severe relapse	+	11th day	22d day	22d day to 32d day	0	+
34	38	Male	Mild	++	5th day	17th day	17th day to 39th day	+	0
36	21	Male	Severe	+	13th day	24th day	24th day to 81st day	0	0
38	23	Female	Moderate	Scant	9th day	19th day	19th day to 43d day	0	+
41	30	Male	Fatal	+	7th day	10th day	10th day	+	0
49	12	Male	Severe relapse	++	7th day	24th day	24th day to 48th day	0	+

FREQUENCY OF TYPHOID BACILLURIA. In determining statistically the frequency of this condition, it was at once seen that a grouping of the various series of observations was imperative, and that the percentage of the frequency of typhoid bacilluria, to be approximately correct, owing to the frequent errors in cross references, should be based only upon original articles personally reviewed.² The series accepted comprises apparently consecutive and unselected cases³ of typhoid fever, sufficiently examined to detect any lasting

² I could not find the original papers of these series:

Year.	Name.	Number examined.	Number positive.
1897.	Levy and Gissler	22	10
1901.	Gualdi	105	51
1901.	Ischikawa and Kaharhi	24	15

³ The following are not included in the statistics, being selected or special groups of cases, and therefore not a fair average:

Year.	Name.	Number examined.	Number positive.
1900.	Horton Smith (selected cases)	6	6
1903.	Flamini (children)	8	7
1899.	Schichhold (severe cases)	17	5
1897.	Besson (nephritic cases)	33	6

bacilluria,⁴ and of such type⁵ and recent period⁶ as to make the identifications of the bacilli trustworthy.

Based on the following 621 cases, of which 150 showed typhoid bacilli in the urine, it may be stated that typhoid bacilli can be detected in the urine of 24 per cent. of all cases of typhoid fever.

Year.	Name.	Number examined.	Number positive.
1897.	Horton Smith	7	3
1898.	Richardson	38	9
1899.	Richardson	66	14
1899.	Horton Smith	12	4
1900.	Neufeld	12	3
1900.	Horton Smith	39	11
1901.	Vincent	46	9
1901.	Shuder	22	5
1901.	Klimenko	65	13
1902.	Jacobi	35	7
1902.	Fuchs	41	4
1903.	Sato	17	11
1904.	Herbert	98	18
1905.	Lesieur and Marehand	26	11
1906.	Brown	15	8
1906.	Lesieur	6	3
1907.	Vas	26	6
	Connell.	50	11
		621	150

⁴ It does not appear that these cases were sufficiently examined:

Year.	Name.	Number examined.	Number positive.
1898.	Petrusky (not followed for per cent.)	50	3
1901.	Lewis (technique in doubt)	45	1

⁵ In these cases the identity of the bacilli was not determined:

Year.	Name.	Number examined.	Number positive.
1902.	Bliss	311	31
1904.	Knox	100	51

⁶ The following are excluded because of having been reported prior to the period of accurate differentiation of the typhoid bacillus:

Year.	Name.	Number examined.	Number positive.
1881.	Bouchard	65	21
1886.	Seitz	7	2
1886.	Wyssokowitsch	7	2
1886.	Hueppe	18	1
1887.	Berlioz	14	2
1889.	Konjajeff	20	3
1888.	Neumann	23	6
1890.	Neumann	48	11
1890.	Karlinski	44	21
1892.	Silverstrini	7	7
1892.	Enriquez	12	7
1894.	Borjes	10	2
1895.	Barte de le Falle	27	4
1895.	Wright and Semple	7	6
1895.	Blumer	10	2
1895.	Melchior	4	1

From the standpoint of preventive medicine, of more importance than the mere percentage of bacilluria is the number of bacteria present, and the time and duration of their occurrence.

THE NUMBER OF BACILLI. The bacilli are usually found in enormous numbers, often so many being present as to render the urine turbid. The actual count of bacteria varies greatly from day to day and from hour to hour, but often runs into the millions and occasionally into the hundred of millions of organisms to the cubic centimeter of urine. Petrusky found 172,000,000 bacilli to the cubic centimeter in one case; Gwyn estimated 500,000,000 to the cubic centimeter in another. Less frequently the bacilli are found in scant numbers, sometimes averaging even less than one bacillus per cubic centimeter of urine (Jacobi, Besson, Connell). Some few writers (Fuchs, Schichhold, Flamini) have found the bacilli few in number in most of their positive cases.

TIME OF OCCURRENCE. The bacilli invade the urine and are detected most frequently in the declining stage of the disease, at about the time when the temperature reaches normal. Several early observers recovered bacilli, supposedly typhoid, from the urine in the first few days of the disease. Possibly these observers were dealing with proteus or colon contaminations, as no recent observer has confirmed their findings. However, Pavlovsky has demonstrated experimentally the probability of a "period of distribution" prior to the actual febrile invasion of various diseases. His investigations have shown the quick excretion of typhoid bacilli in the urine supposedly by the eliminative efforts of the renal epithelium.

As to the earliest appearances recorded by recent observers, Schichhold, out of six cases of bacilluria, found the earliest infection of the urine on the seventh day. Jacobi, in eight cases, found the earliest infection on the eighth day. Lesieur and Marchand state that in three of their eleven cases bacilli were found first on the ninth, tenth, and eleventh days respectively.

In one case of my series, on the tenth day of the illness, I recovered the typhoid bacillus from one of two bouillon tubes, each planted with 1 c.c. of urine.

Horton Smith, in 17 cases, found the earliest infection on the thirteenth day; Richardson, in 9 cases, on the fifteenth day; Neufeld, in 3 cases, on the twentieth day; Shuder, in 5 cases, on the twenty-fifth day; Brown, in 8 cases, on the twenty-eighth day. The usual time of onset of bacilluria has been after the third week of the fever.

The finding of the bacilli in the urine has been more constant in relation to the temperature curve than to the day of disease. In Richardson's nine cases of bacilluria, the bacteria were first found in the various cases from a few days before the temperature reached normal to a week after; in Shuder's, from a week before to three weeks after; in Petrusky's, from a few days before the fall of temperature until ten days after; and in Brown's eight cases the earliest

finding varied from a week before to two weeks after normal temperature had been reached. A few careful observers of limited series, such as Jacobi, have found the majority of infections to occur first during the stage of fever. No doubt with many observers the bacteria often escape detection at this period, for when found during the febrile stage the number of bacteria has usually been scanty and their duration in the urine brief. In a few cases the first appearance of the bacilli has been during a relapse. Analyzing the cases reported by the various observers, it may be stated that, as a rule, the bacilli first appear in the urine from one week before to two weeks after the temperature has reached normal, most commonly within a few days of the first day of normal temperature.

Of my positive cases, if we exclude the one mentioned in which a stray bacillus was recovered from a single tube on the tenth day of fever, none of the remaining ten occurred during the stage of high continuous temperature. One case was positive on the seventeenth day in the stage of steep curves; the remaining nine were first positive in the period from eight days before to eight days after the temperature had reached a continuously normal line.

DURATION. The bacilli usually persist in the urine for several weeks and disappear spontaneously in most instances. However, a considerable proportion of cases continue long into the ambulatory stage, sometimes for years, rendering the patient a grave menace to public health. Not many observers have followed these cases for the purpose of noting how long the condition may continue. Richardson followed 7 cases, 2 of which cleared up in the hospital; the other 5 left the hospital with their urine swarming with typhoid bacilli. Petrusky followed 3 cases, in which the shortest duration was eight days, the longest was three months. Shuder's and Fuchs' cases were of brief duration. Horton Smith followed 5 cases, finding the shortest duration eight days, the longest seventy days. Sato's cases lasted from eight to forty-two days.

Of my 5 untreated and non-fatal cases, the shortest duration was fourteen days, the longest forty-two days. In 4 cases the bacilluria was terminated by treatment, on the fourteenth, sixteenth, twenty-fourth, and fifty-seventh days of their duration. One patient died.

Longer duration of the bacilluria is not uncommon. Rousig examined sixteen German soldiers returning from the siege of Pekin six months after their attacks of typhoid fever, and found the urine of one swarming with typhoid bacilli. Houston found typhoid bacilli present in the urine in pure culture at the end of three years, and Young followed for two years a patient who had wandered seven years since his attack of typhoid fever, a menace to the whole community; and Liebrau reports among other cases of typhoid carriers one who after nine years showed typhoid bacilli in the urine.

CONDITIONS DETERMINING THE OCCURRENCE OF TYPHOID BACILLURIA. The generally accepted theory to account for the number and continuance of typhoid bacilli in the urine is that the urine, having become infected from the blood by a few organisms, serves as a culture medium. It is not reasonable to suppose that all or even any large number of the bacilli existing in the urine are eliminated from the blood by the kidney, considering, first, the relatively small number of bacteria in the circulating blood even during the height of the disease; second, the fact that the usual period of bacilluria occurs at a time when no organisms can be detected in the blood; and third, that a bacilluria may be terminated in most cases by antiseptic irrigation of the bladder. For instance, Horton Smith found no bacilli in the blood of four cases which showed in the urine enormous numbers of bacilli. The same result was obtained by me in two cases. Gwyn and Richardson found that vesical irrigations of mercuric chloride terminated the bacilluria; and I have used irrigations of silver nitrate successfully. Therefore, no considerable number of the bacteria in the urine are direct eliminations from the blood.

CHANNELS OF INFECTION. That infection of the urine can occur by the urethra seems proved by a patient of Brown, who developed a pure typhoid bacilluria and cystitis by infection from a catheter. Lesieur has experimentally demonstrated this mode of infection in dogs. The bacilli so planted multiplied and persisted for a month or more. That infection by the urethra is the usual mode is highly improbable, as is, also, the theory suggested by Blumer, that the bacterium finds its way from the rectum through the posterior vesical wall. Nor are cases of suppurative foci of the genito-urinary tract, such as Flexner's case, sufficiently common to furnish an adequate source of urine infection. In 289 postmortem examinations on typhoid fever cases, Horton Smith reported that in only one case were there suppurative foci of the kidney that would account for bacilli in the urine. The generally accepted theory of the mode of infection is that a bacillus finds its way from the blood stream, through the kidney, into the urine, and is washed into the bladder; and there, finding in certain cases a stopping place and a satisfactory culture medium, it proliferates.

The bacilli probably exist in the blood in all cases. They are recoverable in a high percentage, 75 per cent. of the 1602 cases collected by Coleman and Buxton. The bacilli have been repeatedly recovered postmortem from the kidney, as from other organs. That the kidney excretes bacteria, or permits their passage has been experimentally proved by Pavlovsky. Especially the excretion is profuse in the stage of distribution before body resistance is manifested by symptoms of disease. In pyogenic and pneumonic infections, as well as in typhoid, the specific bacteria have been recovered from the urine. It is a moot question whether the elimination

of bacteria is a normal kidney function, or is dependent on renal damage, be it ever so minute and localized. I am inclined to the latter view.

The kidney presents, histologically, interstitial lymph nodules and an immense vulnerable capillary network, in which structures septic typhoid emboli are demonstrated in many instances. At the New York Hospital laboratory of pathology, minute focal necroses are frequently found in the kidneys of severe cases of typhoid fever.

At least temporary damage to the renal epithelium, as evidenced by the coarse laboratory determinations of albuminuria, is the rule at some stage of the long-continued typhoid intoxication. (Besson, found 47 cases positive for albumin out of 77; I, 35 positive out of 50.) However, detectable damage does not seem necessary, for a single lesion in a glomerulus or tubule would seed the urine as effectually as a gross nephritis; yet this damage would not be expressed by detectable albumin. That these minute local lesions must be of frequent occurrence even in healthy individuals is evident to anyone who has searched earnestly for histologically perfect renal tissue. Lesions elsewhere in the urinary tract, when such occur, would also allow, equally as well as renal lesions, the egress of the bacilli from the blood.

The microorganisms do not usually persistently infect the entire urinary tract, but become localized in the bladder. This has been proved by Richardson, Gwyn, and me, in cases terminated by antiseptic vesical irrigation, showing that the bacilli were local in the bladder, and also in Horton Smith's case, in which a culture from the bladder and kidneys, postmortem, showed that in this case the bladder urine alone was infected.

THE URINE AS A CULTURE MEDIUM. Merkel and Goldschmitt, among the early investigators, demonstrated that typhoid bacilli could multiply in the urine in the test-tube, especially when this was weakly alkaline or neutral. Horton Smith, in 1900, inoculated six specimens of urine. The bacilli grew profusely in four, scantily in two. Park, in 1901, inoculated forty-five specimens of urine with those bacteria, other than the typhoid bacillus, which commonly infect urine. The growth varied, dependent chiefly on the acidity of the urine. For these other organisms (Colon bacillus, streptococcus, etc.) he found that high degrees of urine acidity inhibited growth.

To determine why the typhoid bacillus thrives in certain urines only, I took three tubes of typhoid urine in each of forty consecutive catheterizations. One tube was planted with a loop of bouillon culture of typhoid, two were held as controls, and were incubated for forty-eight hours. Of these forty sets, nine were discarded because of contaminations, and four because of obscuring phosphatic precipitates. The growth and analysis in the remaining twenty-seven were noted.

In 6 of the 27 specimens the bacilli multiplied so rapidly as to cloud the urine in twenty-four hours. This increase was about half as rapid as in bouillon similarly inoculated. Most of the organisms were sluggish or non-motile; a few were actively motile. In 9 of the 27 specimens the growth gave a faint cloud of bacteria in forty-eight hours. Twelve remained unclouded. However, even these latter, on examination in hanging drop, showed a considerable increase in the number of sluggish and non-motile typhoid bacilli over the original number planted. The organisms were roughly proved in each case by transfer to litmus milk and by prompt agglutination at a serum dilution of 1 to 50.

To summarize the more important observations on these 27 specimens: In specific gravity, six specimens were below 1012. In all of these the bacteria clouded the urine within forty-eight hours. Sixteen varied from 1012 to 1024. In 9 of these the bacteria clouded the urine; in 7 there was no clouding. The remaining 5 specimens were above 1024 in specific gravity. All these remained clear.

As to albumin content, of the 22 specimens which were below 1024 in gravity, 6 specimens contained albumin. Of these, 4 were good media, 2 were poor. Of the five urines above 1024, 2 contained heavy traces of albumin. Both were poor media. Albumin seemed from these observations to be no important factor in the growth of the organisms.

The acidity of the twenty-seven urines was determined by titration with decinormal sodium hydrate, using litmus as an indicator. The urines in which the organisms grew best were weakly acid, neutral, or alkaline to litmus. The more acid urines showed only a slight growth. Even the most acid specimens were merely inhibitory, not bactericidal, for from three of these highly acid urines, kept at room temperatures, living typhoid bacilli were recovered two months after inoculation. It seemed evident from these observations that the most important factor in determining cultural conditions was the degree of acidity of the urine. Therefore, I have recently (1906-1908) inoculated a series of urines to determine the degree of urine acidity influencing typhoid growth.

The specimens used were albumin-free urines, thirty-eight in number, freshly passed by normal individuals who were not receiving any medication. Ordinary analysis was made of the urine, then the acidity was determined by $n/10$ NaOH, using phenolphthalein as an indicator.

The urine acidity expressed in percentage of $n/10$ NaOH ranged from 4 to 112 per cent. No urine tested was neutral or alkaline to phenolphthalein, although some of the urines of low acid percentage by phenolphthalein were neutral or alkaline to litmus.

Ten c.c. of filtered sterile urine was planted with a loop of twenty-four-hour bouillon culture of typhoid bacilli, and kept at

38° C. for two days. The growth was noted in hanging drop and given an approximate index, using 100 as a basis for those urines in which the growth was best. In the urines given the highest rating the bacteria developed in forty-eight hours to about the same extent as they do in bouillon in twelve hours. The results noted follow:

Per cent. of urine acidity in terms of n/10 NaOH.	Growth index.	Per cent. of urine acidity in terms of n/10 NaOH.	Growth index.
4	100	28	10
4	100	30	10
7	100	33	10
8	100	36	5
9	30	38	10
10	100	40	0.5
10	10	50	1
12	100	52	15
12	20	53	10
12	50	54	0.5
14	40	60	4
15	80	66	3
15	10	73	0
15	80	80	0.5
16	40	87	2
17	100	90	3
18	80	110	2
22	80	110	0
26	80	112	0.5

Of the above urines, in those of low acidity, that is, below 20 per cent. n/10 NaOH, the bacteria usually thrive. These were straw colored, or light amber urines, below 1018 in specific gravity. In the urines of medium acidity, that is, 20 to 40 per cent., the bacilli were inhibited in growth to variable degrees; and in the highly acid urines they were markedly inhibited.

To make sure that such inhibition was not due to lack of food, two of these strongly acid urines were diluted one to four with water, sterilized by filtration, and inoculated. In these diluted specimens the bacilli grew luxuriantly, whereas in the undiluted specimens the growth was scanty.

It was further determined that the inhibition was not due to the neutral saline contents, for on partially neutralizing the acidity of the urine by the addition of concentrated sodium hydrate, in four acid urines of poor cultural character, the urines became good media for the growth of the bacilli. The inhibition seemed due, therefore chiefly to the acid contents of the urine.

However, it was found that the degree of inhibition did not bear a constant relation to the degree of acidity; for instance, one urine of an acidity of 10 per cent. had a growth index of 100, and another of the same percentage, a growth index of only 10; also in the experiments in reducing acidity by sodium hydrate, it was found that a urine of an acidity of 112 per cent. reduced to an acidity of 90 per

cent. had a growth index of 60, whereas a urine of natural acidity of 90 per cent. had a growth index of only 3. It, therefore, seemed probable that the inhibitory factor was not the total acidity, but some particular acid or group of acid bodies.

To determine what the inhibitive acidity was, I made further observations. Acid sodium phosphate was first experimented with. Urines of low acidity (6 specimens) which grew the typhoid bacillus well were acidified with acid sodium phosphate to 20, 40, 60, 80, and 100 per cent. $n/10$ NaOH. At 60 per cent. one specimen showed moderate inhibition; at 80 all specimens showed moderate, and at 100, complete, inhibition. From the large amount of sodium phosphate needed to inhibit growth, it was evident that this was not the inhibitory substance in those urines which showed marked inhibition when the natural acidity was 30 to 40 per cent. $n/10$ NaOH.

Organic acid then suggested itself. Acetic and lactic acid as types of feeble dissociating organic acids were added to 6 urines of low acidity and good cultural character. At 2 per cent. $n/10$ NaOH these acids were markedly inhibitory, and at 15 to 20 per cent. were absolutely inhibitory to growth of the typhoid bacillus. The same results were obtained with uric acid in minute quantities.

Folin has shown that a high and varying percentage of urine acidity is due not to sodium acid phosphate, but to organic acids, for the most part of undetermined nature. These in certain of his specimens accounted for more than 50 per cent. of the total acidity. Paus has proved the inhibitory effect of the amino, oxybutyric, and other acids identical with or allied to the organic acids of the urine; these acids, in strengths of 0.2 to 0.3 per cent., are as absolutely inhibitory to the growth of typhoid bacilli as acetic and lactic acids, and one-third to one-half as inhibitory as the dissociating mineral acids, such as hydrochloric. These observations warrant the conclusion that the inhibitory factor in the urine is usually the organic acidity, which, when in excess prevents the growth of the typhoid bacillus.

It is known that in fever, metabolism is much increased and the nitrogenous output is excessive. The usual acidity, as I determined in titrating over two hundred typhoid fever urines, ranges in the high febrile stage from 30 to 80 per cent. $n/10$ NaOH, with an average of about 40 per cent.; in the declining and post febrile stage, the range is 4 to 30 per cent., with an average of about 12 per cent.; and in the stage of active convalescence, 4 to 50 per cent., with an average of about 20 per cent. To the high acidity of the febrile stage, and possibly to a high ratio of organic acidity, I attribute the infrequency of bacilluria and the small number of bacilli and the short duration of bacilluria at this stage. In the declining and postfebrile stage, cultural conditions are improved by the dilution of the urine and low acid output. If in the urine,

which is a good culture medium at this stage, the bacterium appears, it proliferates enormously, particularly if there be a trace of albumin present.

In evidence of the low organic acidity of this latter stage, Roper has found at the New York Hospital, in a series of total nitrogen determinations on the urine of convalescent typhoid fever patients, that in the post-febrile stage the uric acid falls to a negligible quantity.

To determine if enriching the urine by the addition of serum albumin modified the inhibitory effect of urine acidity, faint traces were added to twelve urines of varying acidity. The reduction of acidity by such addition was so slight (1 to 2 per cent.) as to be negligible. Serum albumin added to diluted, faintly acid urines considerably increased the value as culture media for typhoid bacilli. Added to more acid urines, the albumin was without appreciable effect. The conclusion from this limited series is that while albumin acts as a food for the bacteria, the increased value to the urine as a culture medium is not marked enough to mitigate the inhibitory effect of excessive acidity.

RESIDUAL URINE AND STASIS. The bacteria, in addition to finding a favorable medium for growth, must find a resting place, else they will be mechanically expelled from the urinary passages by the outflow of urine. This factor in the establishment of an enduring bacilluria, a certain degree of stagnation of urine in the bladder, seems to be particularly favored by the nature of typhoid fever. The period of illness is long, the muscle tone poor, the patient apathetic, the bladder often distended and incompletely evacuated. Hence, in the latter stages of the disease, when the urine becomes a favorable medium, any typhoid organism coming down the ureter finds in the urinary bladder a stopping place, from which it is not expelled until it has many times multiplied and effectually seeded the bladder urine.

During the height of the fever the bladder is often overdistended. The clinician not infrequently finds the bladder of the apathetic or delirious patient reaching half way to the umbilicus, distended by 20 to 30 ounces of urine. This partial retention is often overlooked; it yields to expectant measures, and is not considered worthy of note. Yet the effect of such overstretching of weakened muscle layers must reach far into the convalescence and must frequently result in residual urine. That retention does not more frequently lead to immediate bacilluria must depend on the inhibitory effect of the acid urine of the febrile stage, rather than on an assumption, proved to be erroneous, that bacteria do not escape into the urine at this stage.

The influence of retention was investigated by Bliss. In following 311 cases, he observed 39 who suffered from retention. 23 per cent. of these cases developed later a bacilluria, while only 8 per cent.

of those cases which had had no retention developed urine infection. Retention occurred as an early symptom; the bacilluria late.

My attention was particularly directed in one case to the possibility of retention as a predisposing cause of bacilluria. This patient, a young adult male, had suffered from retention in the height of the disease. Treated for bacilluria in the ambulatory stage of typhoid fever, the condition failed to yield to an eight day's course of urotropin. Although the bacilli diminished promptly, they did not entirely disappear. He was, therefore, catheterized for purposes of bladder irrigation. On inserting the catheter directly after completed urination, four ounces of residual urine was found in the bladder.

Subsequently, three other bacilluria cases were similarly catheterized for residual urine. One had only a normal amount of about 1 dram; one had over 1 ounce; and one about 5 ounces. It is clear that residual urine would invite and harbor the growth of typhoid bacilli as it does the growth of other bacteria, as in colon, proteus, and streptococcic infections of the urine, which are not at all uncommon in typhoid fever patients.

TYPE OF TYPHOID FEVER. The bacilluria occurs most frequently in severe types of typhoid fever, particularly in the complicated and relapsing types. This has been the uniform experience of all the observers except Klimenko. Of my 50 cases, 3 were fatal, 14 severe, 17 moderate, 16 mild. Of the 11 bacilluria cases, 1 was fatal, 6 severe, 2 moderate, 2 mild. This gives 63 per cent. of severe and fatal cases in the bacilluria series, against 34 per cent. in the total cases. The percentage of relapses in the bacilluria cases was 36 per cent., against 20 per cent. in the total series.

CHARACTER OF THE ERUPTION. The bacilluria appears to be independent of the eruption of typhoid fever. In some few cases of recent observers, the two have been coincident, both no doubt indicating the distribution of minute septic emboli. In general, the majority of observers agree that the infection of the urine occurs more frequently in those cases which have borne a well-marked eruption. In my series of 50 cases, 11 bore a well-marked eruption, 12 a moderate, and 20 a scanty eruption; and in 7 cases no spots were observed. In the bacilluria cases, the eruption in 3 was well marked, in 7 moderate, and in 1 scanty.

ALBUMINURIA. Albuminuria is frequently co-existent with typhoid bacilluria. Its relation to the presence of the bacilli has been the subject of discussion, based on diverse findings of individual investigators. That a closely dependent relation exists, such as was insisted upon by Bouchard and Seitz, and later by Besson and Schichhold (that is, without albuminuria, no bacilluria), is refuted by the observations of the majority of investigators. True, the greater number of all cases of bacilluria reported have shown a co-existent albuminuria, and in a small number of these cases the

two conditions have been synchronous in onset, in duration, and in disappearance. On the other hand, the majority of urines which contain albumin, coming usually in high febrile stages, show no bacilli.

The typhoid bacilli have appeared in the urine in fully one-third of all cases that contain no detectable albumin; they have appeared in the urine in many instances in which at no stage of the disease has albumin been observed (Brown, 4 out of 8 cases; Vincent, 2 out of 9; Vas, 2 of 4; Lesieur and Marchand, 3 of 10); and finally, they have disappeared spontaneously from urine which continued to contain albumin, and have persisted in urine from which the albumin had vanished (cases of Brown, Vas, Richardson, Horton Smith, and others). Therefore albuminuria is not a necessary factor in the establishment of typhoid bacilli in the urine. Albumin, if present, improves the urine as a culture medium, as has been shown, and presumably its presence indicates a more or less incompetent condition of the kidney.

Of my 50 cases, 35 had albuminuria at some period, usually the high febrile stage, a ratio to the total of 70 per cent. Of the 11 bacilluria cases, 7 showed at some stage serum albumin, varying from a very faint trace up to 0.1 per cent., a ratio of 64 per cent. Of these 7 cases, 5 showed albumin at sometime when the bacilli were also present. In one case the bacilluria came on simultaneously with albuminuria. In 2 cases the albumin disappeared before the bacteria. In 1 case albumin persisted after the bacilli had spontaneously disappeared. Care was taken to avoid confusing pus with serum albumin.

CLINICAL COURSE OF BACILLURIA. 1. *Symptoms.* As a rule, typhoid bacilluria gives no suggestive symptoms; even when the urine contains a heavy sediment of pus in addition to the swarming bacteria, the patient rarely complains of frequency, burning, or tenesmus. Infection of the urine with organisms other than the typhoid bacillus is by no means rare in typhoid fever. In these cases symptoms are often present. But to the typhoid organism itself the bladder seems very tolerant, possibly because this bacterium in its growth does not markedly alter the reaction of the urine, nor tend usually to invade the bladder wall.

Objectively, the urine is often turbid from the enormous number of bacilli. This is the rule in the bacillurias occurring during convalescence. Horton Smith noted turbid urine in 23 out of 26 typhoid bacilluria cases; others observed it less frequently, Shuder even finding no turbidity. Eight of my cases showed turbidity at some period of the bacilluria. The degree of turbidity varied much in the given case from day to day, the urine usually clearing macroscopically some days before it was sterile on culture.

A shimmer on swirling the urine in a test-tube has been described. This is due to the reflection of light from the different planes of

moving bacteria, but it is not characteristic of the typhoid organism alone, occurring in any bacilluria, unless obscured by pus or precipitate. Pus, usually in small quantity, is present in the majority of those cases showing turbidity. In how far this condition, in the absence of subjective symptoms and in consideration of its ephemeral character, may be dignified by the term cystitis, is a matter for individual determination.

2. *Complications.* The cases of true cystitis due to the typhoid organism alone, with sharp subjective symptoms and pathological changes in the bladder wall are exceptional. Acute cystitis or pyelitis appearing during the course of typhoid fever is usually due to some other organism. Vincent, in 1200 cases of typhoid fever, noted only two cases of acute cystitis due to the typhoid organism, coming on in convalescence. In rare instances the typhoid bacillus produces ulcerative lesions simulating those produced by the tubercle bacillus. Rousig observed an acute cystitis for two months, until the death of the patient, which was caused by the typhoid bacillus alone. This case on cystoscopy showed deep ulceration of the bladder. Brown reported a case with like bacteriological and cystoscopic findings, apparently arising from using an infected catheter. Houston reported a case of severe typhoid cystitis. It is of interest to note that the only tangible source of the urine infection in this case was by exposure while nursing a case of typhoid fever three years previously. Young reported a case in which the cystitis had been of five years' duration, following an attack of typhoid fever. The man had a history of previous venereal and prostatic disease. Cultures showed considerable numbers of typhoid bacilli accompanied for a time by the gonococcus. The bladder retained 16 ounces of residual urine, and on cystoscopy showed chronic ulcerations. This case was treated unavailingly for two years, when the man disappeared.

A patient with pyonephrosis recently operated upon at the New York Hospital by Dr. F. W. Murray contained the typhoid organism in pure culture. The infection probably dated from an attack of typhoid fever five years previously. The man was also supposed to have had an attack of typhoid fever eighteen years previously.

In that unusual invasion of typhoid fever, such as the nephrotyphoid case reported by Napier and Buchanan, in which the kidney rather than the intestine is the prominent organ of initial bacterial attack, the bacilluria is probably secondary to the renal invasion.

3. *Termination.* Why typhoid bacilli once established in the urine should disappear spontaneously is a difficult question to answer with accuracy. Yet the answer is of importance, not only on theoretical grounds, but also from the standpoint of actual practice. General body resistance is probably no factor in the dis-

appearance of the microörganism. The termination bears no relation to the appearance or intensity of the agglutinating power of the blood serum, if we may take the agglutinins as an approximate index of the bacteriolysins. The bacteria appear and disappear in the early stages of typhoid fever, before the serum reaction has appeared; they appear and disappear in the afebrile stage when resistive powers have fully developed. Phagocytosis evidently plays no part, for the leukocytes of the urine do not contain noteworthy numbers of bacilli, and the bacteria disappear from urine which contains no excess of leukocytes.

Agglutinins and antitoxins in the urine play no proved part. Certain investigators have found that minute quantities of various agglutinins do come through the kidney. This has not been satisfactorily proved of typhoid. Although the bacilli appearing in the urine in typhoid fever do tend to be stunted and have lost in whole or in part the active motility seen in bouillon culture, yet in my experience the same phenomenon is observed if typhoid bacilli are planted in normal urine of equal acidity. Vincent reported the feeble agglutination of typhoid bacilli in the urine from a case fourteen days ill, and from another of thirty-seven days. In eight cases I could not confirm this observation. Actively motile bacilli were placed in the urines of 8 febrile and convalescent typhoid fever patients who gave in the blood serum intense agglutination. In none at the end of twelve hours could any more clumping or cessation of motion be observed than in normal urines of like acidity.

Bacteriolytic action does not explain the disappearance, for the urines from which the bacteria have disappeared spontaneously sometimes continue favorable media for typhoid growth. Four such urines were planted *in vitro*. In one the bacilli developed luxuriantly, in the other three scantily. Mechanical outwash alone does not explain the disappearance, for frequently the bacteria first appear or markedly increase during the stage of polyuria, when the outwash is great.

The most satisfactory explanation is that the bacteria, usually finding no foothold other than the bladder urine, come upon a period when the urine is a poor medium; growth is inhibited, but the outflow is continued. Thus gradually the last bacterium is washed from the bladder.

On this hypothesis the factors favoring cure are, first, any condition that acidifies the urine or otherwise makes it a poor medium, such as fever, increased metabolism, or diminished water ingestion; second, any factor increasing the expulsive power of the bladder, such as upright posture and improved general muscular tone. Occasionally, in spite of one or the other of these factors, the bacteriuria continues. In these cases it has usually been noted that some unusually favorable feature was present; as, for instance, in

Jacobi's cases, in which, in spite of high temperature, the bacilluria continued, it is presumable that the accompanying nephritis and hematuria repeatedly re-infected the urine; and, again, in such cases as Young's and Houston's, persisting over years in spite of the upright posture, not only the urine but also the bladder wall has been found to be infected. In the absence of any actual tissue infection, it must be assumed in accounting for such cases as Roussig's, lasting over periods of months, that either the urine remained a good medium over this period or that the bacilli were harbored in some unusual way, as, for instance, in residual urine, this latter apparently accounting for a persistent case of my own.

Of five personal cases which cleared up spontaneously, the bacteria disappeared in four, presumably from the causes stated. In the fifth case the typhoid organisms were overgrown by newly implanted, more vigorous bacteria. In this case the urine showed typhoid bacilli in pure culture on the twenty-second and twenty-sixth days. Then on account of retention the patient was repeatedly catheterized. Cystitis developed and cultures on the twenty-eighth day showed colon bacilli as well as typhoid. On the thirty-first day the urine had become ammoniacal and cultures showed only colon and proteus, no typhoid bacilli.

VIRULENCE OF TYPHOID BACILLI IN THE URINE. Horton Smith found the typhoid organism occurring in the urine to be as toxic to animals as the one from the feces or blood. There is no direct proof of its pathogenesis in man by the Koch cycle. The nearest approach to the cycle is a case related by Sheele, of a servant who in misapprehension drank from a flask in which some urine had been secreted by a typhoid fever patient. She herself developed typhoid fever twelve days later. There is no reason to doubt the virulence of these organisms. Morphologically, culturally, biochemically, and in so far as the serum reactions are concerned, these organisms do not differ from the organisms obtained from the blood or the stool.

DIAGNOSTIC VALUE OF TYPHOID BACILLI IN THE URINE. As an aid to diagnosis in the average case of typhoid fever, bacterial search of the urine is of minor importance. The condition usually occurs late in the disease and in a relatively small number of cases as compared with the blood infection, and the technical difficulties surrounding clean catheterization, particularly in women, are greater than with the serum reaction or the blood culture. In five cases in which the blood was observed as well as the urine, Lesieur and Marchand found the appearance of the bacilli in the urine to be uniformly later than their appearance in the blood.

However, in the atypical and irregular cases urine cultures are frequently of great diagnostic value. Particularly in the renal type of typhoid invasion, and in the overwhelming septicemic types, it is of value, often being the earliest means of exact diagnosis in

such cases. Revillard observed a patient who presented the symptoms of a unilateral septic kidney, while a case of Singer simulated a meningitis of mastoid origin; in both the correct diagnosis was reached by culture of the urine, and Napier and Buchanan reported a case at first diagnosticated as idiopathic acute nephritis.

In one case only of my eleven, did the finding of the bacillus antedate a positive Widal reaction. In this the bacterium was found on the seventeenth day; the serum agglutination did not appear until the fifty-second day, during a relapse.

TYPHOID BACILLURIA A PUBLIC MENACE. To the patient the condition is usually not a menace. Complications are unusual; the bladder tolerates the presence of the organism; the resistive forces are such that general re-infection is improbable. But to the non-immune public the condition is a real menace. Indeed, the urine may well be considered the most dangerous of all excreta.

The dearth of subjective symptoms makes the condition one that is easily overlooked. Nor are the objective signs of obtrusive prominence. The stool, not the urine, has borne the brunt of popular condemnation and prophylaxis, for the stool is offensive physically; it is closely associated in the public mind with the notion of typhoid fever as a strictly enteric condition. The soiling of bath and linen by fecal matter is evident and quickly cared for; the stool is guarded more carefully from the fly, and is crowded through to disinfection with greater celerity.

Furthermore, as against fecal dissemination, the stool contains its maximum number of typhoid organisms only at the height of the illness, when the patient is under the closest observation. In the latter stages, when control over the patient is being relaxed, the typhoid organisms have usually disappeared from the intestine; the ulcers which sowed the feces have healed; the typhoid bacilli free in the intestine have been overrun by the more vigorous colon, proteus, and other saprophytic organisms; and, unless the bile has become infected, the bacilli have ceased in the stools. Herbert, in 216 examinations of stools in 98 cases of convalescent typhoid fever patients, found the organism in the stool in only 3 cases. In the urine of these 98, he found the bacilli in 18 cases.

Although with the newer media, such as the Conradi-Drigalski, the organism can be recovered in practically every case by a persistent search in the feces of the active typhoid fever case, and although against this can be set only 24 per cent. of cases in which the urine has been proved to be infected, yet considering the stage at which the bacteria appear in the urine, the period of duration of the bacilluria, the greater likelihood of carelessness with the urine, the overwhelming numbers in which the bacteria appear, and the frequency and promiscuousness of urination as compared with defecation, the conclusion is inevitable that the urine of typhoid

fever is the great spreader of this disease. Such is the opinion of Horton Smith, Knox, Lesieur, and many other competent judges.

There can be no question that the urine of the immediate post-typhoid patient is a serious menace to the community, far outweighing the dangers of fecal dissemination. But when it comes to periods long after typhoid fever and to the consideration of those cases which years after their attacks of typhoid fever carry virulent organisms in their bodies, and continue to infect their fellowmen, such cases of typhoid bacilli carriers as have been run to earth by Liebetrau, Kayser, Soper, and many others, the urine is found far less frequently at fault than the feces. This is as one might assume in considering the urine as a medium in which the growth of the organisms is frequently inhibited by high acidity, as against the bile in which, as shown by Conradi, typhoid bacilli flourish at all times, especially according to Foerster when slightly albuminized by inflammatory exudates.

With the active menace of this condition of bacilluria in view, it must become a rule so to treat every case of typhoid fever as to avoid danger of urinary dissemination of the disease.

TREATMENT OF TYPHOID BACILLURIA. The condition demands treatment chiefly from the standpoint of public health. From the patient's standpoint, drastic remedial measures are unjustifiable, and those used must be the mildest that can adequately cope with the situation. The urine in all stages of typhoid fever must be regarded as highly infectious, and subjected to the same thermal or chemical disinfection as the feces. During that stage in which the condition of enduring bacilluria usually makes its appearance, the urine in the bladder should in every case be rendered unfit for the growth and maintenance of typhoid organisms.

Richardson first in any extensive work called attention to the value of urotropin (hexamethylenamin) as a cure for this condition. He treated nine cases successfully. In several cases the bacilluria was terminated within two days, in all within two weeks. Eight were completely cured by a total of sixty grains of the drug. Horton Smith cites at length 10 cases, and remarks on the marvellous transition in each case from a turbid, oftentimes pus-ridden urine, to a clear urine within a single day, under the administration of this drug. Three cases were cured by ten grains three times a day, in one day, the most obstinate within twelve days. Gwyn of all the observers has met with least success with urotropin. Of three cases, he was successful in one after a total of 165 grains. In another he observed an increase in the number of bacilli during treatment. In the remaining five of his eight cases he resorted to bichloride of mercury, 1 to 50,000 as an irrigation, succeeding in three cases. Brown, Jacobi, and others, have been successful with urotropin. In many instances, however, on the cessation of the drug after administration for two or three days, and in some cases longer, the bacilli reappeared a few days after medication was suspended.

In four carefully followed cases of turbid typhoidal bacilluria, three with a moderate amount of pus, I administered urotropin, five grains, three times a day. The urine became clear within twenty-four hours, and the bacteria disappeared in three cases within seventy-two hours, but in one case they persisted in small numbers up to the eighth day.

To determine if there were active bactericidal property to urotropin urine, three urines from which the bacilli had promptly disappeared under urotropin were planted with a bouillon culture of typhoid. Living bacilli were recovered in each case at the end of twenty-four hours. Inhibitory action, however, was evident, because no increase in the bacilli planted took place. To determine how great was the inhibition, these three specimens were mixed with bouillon in the proportion of 10, 25, and 50 per cent., and inoculated. One urine absolutely inhibited in all dilutions, one in the 25 and 50 per cent. mixtures, and one in the 50 per cent. mixture only. In other specimens from five patients receiving urotropin, 5 grains three times a day, the bacilli uniformly failed to grow in the undiluted urine, and also in the urine diluted 50 per cent. with bouillon. In four of the undiluted specimens the bacteria were still living at the end of a week. In one specimen they had died out. Urotropin, then, while having but slight bactericidal power over typhoid bacilli, is markedly inhibitory. This inhibition persists in the urine for from one to two days after the suspension of medication.

The disappearance of the bacteria from the patient's urine under urotropin seems due not to a positive bactericidal action, but to an inhibition of growth which finally allows the last bacterium to be washed out mechanically. In the majority of cases reported by various observers this inhibition of growth and elimination has been completed within three days. However, cases are not uncommon, though in the minority, in which recurrence of the bacilluria has taken place, on the suspension of the drug, at the end of one to three days. In rare cases, even a two weeks' course of treatment has not sufficed to eradicate the organisms.

It is evident, by the case with which the bacteria are vanquished, that usually the urine alone, not the bladder wall, is infected. The cases of ulcerative cystitis, which fortunately are rare, would seem not amenable to urotropin, no matter how long continued. Such, in fact, was the observation in Young's case, in which long-continued usage of urotropin combined with antiseptic irrigation was unsuccessful in eliminating the organisms. Antiseptic irrigation or surgical drainage would offer the best hope of cure in these cases.

Long-continued administration of urotropin in full doses is to be condemned. In overdose and in susceptible patients the drug is capable of much harm. It is not uncommon to see it produce tenesmus, blood in the urine, and, rarely, even hemorrhagic nephritis. Prudence, therefore, dictates the minimum effectual quantity, and

for the minimum effectual length of time. The limits of such administration remain for future determination, and, indeed, a more acceptable medication may be found. Such is suggested in benzoic acid by the work of Winslow and Lochridge. They have found this almost as toxic to typhoid bacilli as the mineral acids, killing in $n/200$ in forty minutes. Both benzoic acid and its derivative, hippuric acid, are unfavorable to typhoid growth in the urine.

For a routine procedure, Shattuck advises urotropin, ten grains three times a day, twice a week during and after typhoid fever. At the New York Hospital the usual routine of late has been 15 to 30 grains a day, for the week preceding and the two weeks subsequent to normal temperature. Complaints of vesical tenesmus under such administration have not been infrequent (in 4 out of 14 consecutive cases in which I inquired), but in none was there hematuria.

The problem is to secure the maximum inhibitory and curative effect of the drug with the minimal dosage. Since the first 20 grains usually suffice to clear the urine macroscopically, and the continuance of administration of 20 to 30 grains for three days has in a large majority of cases permanently freed the urine from bacilli, the following would seem to be a reasonable rule in the routine treatment of typhoid fever as a prophylactic measure: From the time when the fever approaches normal, and continuing four weeks into the convalescence, every typhoid fever patient should receive half a gram of hexamethylenamin three times a day for three consecutive days of each week. If bacilluria becomes established, it should be treated by the administration of the drug for continuous periods of a week. Failing thus to eradicate the organism, the bladder should be washed out daily with silver nitrate solution, 1 to 5000, or other antiseptic. Chronic ulcerative cases should be drained by cystotomy.

SUMMARY. The facts concerning typhoid bacilluria should be more widely known, and the responsibility of its prevention appreciated.

1. Typhoid bacilli are present in the urine of at least 24 per cent. of all cases of typhoid fever.

2. They are usually found in enormous numbers, appearing at about the time that the temperature falls to normal; and they continue in varying intensity, sometimes intermittently usually for several weeks, tending to disappear spontaneously.

3. The bacilluria arises from infection of the bladder urine from the blood, probably by way of the kidney.

4. Typhoid organisms multiply most rapidly in urine of low acidity. Highly acid urine is inhibitory principally because of the organic acidity. The urine at the height of the fever is usually highly acid and a poor medium; that of the declining stage is low in acid and a good medium for the growth of typhoid bacilli.

5. Atony and overdistention of the bladder and the presence of residual urine are occasionally factors in permitting the typhoid bacillus to become established in the bladder urine.

6. Severe cases of typhoid fever are more subject to infection of the urine than milder cases.

7. The eruption bears no consistent relation to the bacilluria.

8. Albuminuria is not essential to the establishment of the bacilli in the urine. Albumin, however, enriches the urine as a culture medium and indicates such renal damage as might more readily allow the passage of bacteria from the blood.

9. Absence of subjective symptoms is the rule. Objective signs are usually present at some period of the infection; such signs as slight or moderate turbidity of the urine, a shimmer on swirling in a test-tube, or the presence of a small amount of pus. The only dependable sign is the presence of the bacillus proved by culture from the catheterized or cleanly passed urine.

10. Complications are rare. True cystitis occurring during typhoid fever is usually due to some organism other than the typhoid bacillus. Acute typhoid cystitis does occur; and a few cases of pure typhoid infection causing a chronic ulcerative cystitis are recorded, as also are chronic infections of the kidney.

11. The bacilli usually disappear spontaneously. The eliminative agents seem to be, first, an inhibition of growth due to an increased acidity of the urine in the stage of active convalescence, and second, increased power and completeness of urination.

12. The typhoid organism in the urine is virulent.

13. For diagnosis in a case of suspected typhoid fever bacteriological examination of the urine is rarely of value.

CONCLUSIONS. 1. Typhoid bacilluria is a great menace to public health. Of all excretions containing typhoid bacilli, the most dangerous is the urine of the declining and postfebrile stage of typhoid fever. The feces are a greater public menace during the active stage of the illness, but taking the course of typhoid fever as a whole, the urine is probably the great spreader of this disease. However, in chronic typhoid-bacillus carriers, the bile more frequently than the urine is the medium in which the bacteria have perpetuated themselves.

2. As a routine in every case of typhoid fever, during the decline and convalescence, the urine in the bladder should be rendered inhibitory to the growth of typhoid bacilli. Bacilluria once established should be terminated by urinary antiseptics or by irrigation of the bladder. Obstinate ulcerative cystitis should be treated by surgical drainage. The passed urine of the typhoid fever patient at all stages of the illness should be disinfected with the same care as the feces.

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THE SURGICAL TREATMENT OF PERFORATION OF THE INTESTINES IN TYPHOID FEVER.¹

A REVIEW OF THE LITERATURE.

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THE importance of perforation of the intestine in typhoid fever can be best indicated by a brief review of the prevalence of typhoid fever in general, and the report of 369 cases of perforation of the intestine gathered from literature since the classical paper by Harte and Ashhurst,² in which they record 362 cases, with 268 deaths, an operative mortality of 74.03 per cent.

FREQUENCY OF TYPHOID FEVER. The reports of the United States Census Bureau show that in the "Registration Area" for the years 1901 to 1905 inclusive, there was an average per year of 10,458 deaths from typhoid fever, or a mortality rate of 32.2 per 100,000 of population. In 1906 this jumped to 13,160 deaths, the increase being due, in part, to an enlargement in the size of the registration area and also to a higher mortality of the disease in that year. The mortality of typhoid fever in this country is only exceeded by that in Finland, Ceylon, Servia, Australia, Spain, and Italy. In the registration area the highest death rate is found in Pennsylvania, with a mortality rate of 56.5 per 100,000 of population.³ To all these figures the city of Philadelphia has contributed more than one would expect, for from January 1, 1903, to September 15, 1908, there have occurred 32,218 cases, with 4930 deaths.⁴

FREQUENCY OF PERFORATION. Vaughan⁵ states that the frequency of perforation has been variously estimated at from 1.3 to 2 per cent. Of necessity, the statistics vary in different epidemics of the disease. Edsall⁶ has observed that hemorrhage and perforation have a tendency to occur in groups in hospital practice, and he believes it to be a question whether or not complications or severe abdominal symptoms are not due to some secondary infection rather than to the typhoid infection itself. I have collected 21,215 cases of typhoid fever from literature; perforation occurred in 671, a frequency of 3.16 per cent.

ETIOLOGY OF PERFORATION. The causes of perforation may be classified as predisposing and exciting. Among the former is sex,

¹ Read in abstract at the meeting of the Philadelphia County Medical Society, October 28, 1908.

² *Annals of Surgery*, January, 1901.

³ Report of the Commissioner of Health, Pennsylvania, 1905-1906.

⁴ Personal communication from the Director of the Department of Health and Charities, Philadelphia.

⁵ *Washington Medical Annals*, March, 1906.

⁶ *AMER. JOUR. MED. SCI.*, April, 1908.

with the greatest frequency in males. My analysis comprises 281 males and 58 females; in 30 cases the sex is not stated. This preponderance of the male sex is of necessity an incidence of their greater liability to the disease. So, too, age is a factor, the larger number of cases occurring before the age of thirty years. In this analysis 249 cases were under thirty-one; in 75 cases the age was over thirty-one; and in 45 cases it was not stated. Kisberg⁷ quotes Henoch, Baginsky, Morse, and others as stating that perforation is rare in children, a statement which, as Elsburg has shown, is not substantiated by a study of the reported cases. Elsburg notes 25 cases, and I have collected 68 additional cases, all of which were subjected to operation. That children stand operative interference better than adults is well shown by the fact that of these 68 cases only 31 died, a mortality rate of 45.58 per cent. Intestinal parasites may be either a predisposing or exciting cause, or both. Tympany may be a factor in the production of perforation; as Curschmann⁸ points out, when excessive it causes paralysis of the muscular layer of the intestine and consequent immobility.

The exciting causes of perforation are, as a rule, mechanical, and anything that causes a sudden or unusual stimulation of peristalsis must be regarded as a possible etiological factor.

TIME OF PERFORATION. While statistics show that more than 70 per cent. of the cases of perforation occur between the second and fifth week of the disease (in 413 out of a series of 568 cases it occurred during that time), still it should be remembered that perforation may occur at any time during the course of the disease, in a relapse, or even in convalescence. In Goodall's⁹ series of 96 cases, in 9.3 per cent. the perforation took place during a relapse. Briddon¹⁰ has noted a perforation occurring on the twelfth day of convalescence, and Panton¹¹ another on the twenty-seventh day. Pluyette and Allezars¹² report a case of typical typhoid perforation of the ileum occurring two months after the cessation of the fever and unaccompanied by any symptoms of a relapse. So, too, perforation may occur in the ambulatory case as well as in the one in which the severity of the symptoms is marked, but more commonly it occurs in the latter.

PATHOLOGY. The pathology of the intestinal lesions of typhoid fever is so well known that it seems unnecessary again to consider it in detail, save to emphasize the fact that the lesions are, as a rule, situated on the free border of the intestine opposite the mesenteric attachment; thus, at a point where the blood supply is relatively poor, and which in itself predisposes to necrosis and subsequent perforation. As Maylard¹³ has stated, the tendency of the typhoid

⁷ *Annals of Surgery*, July, 1903.

⁸ *Nothnagel's Encyclopedia*, American edition, 1907.

⁹ *Lancet*, 1904, ii, 9.

¹⁰ *Annals of Surgery*, 1896, xxiii, 198.

¹¹ *Ibid.*, 1897, xxvi, 219.

¹² *Marseille méd.*, 1904, xli, 321.

¹³ *Surgery of the Alimentary Canal*, London, 1900, p. 247.

ulcer is to perforate in contradistinction to the ulceration of tuberculosis. It is rare that perforation takes place into the mesentery with the formation of a retroperitoneal abscess; most common is perforation into the general peritoneal cavity. Numerous observers have called attention to the fact that there is but slight tendency to the formation of adhesions and consequent localized abscess; a few such cases have been observed by Da Costa,¹⁴ Holmes,¹⁵ and others.

ANATOMICAL LOCATION. While the ileum is the most common seat of the perforation, no portion of the gastro-intestinal tract, except the duodenum, is apparently exempt.

Stomach. Mauger¹⁶ quotes Milliard as reporting 2 cases and Louis 1 case of perforation of this viscus. Basile¹⁷ reports the case of a woman, age not stated, on whom at operation he found the perforation of a typical typhoidal ulceration of the posterior surface of the stomach. Mazetti¹⁸ states that at autopsy on a patient who died of typhoid fever, he found a perforation of the posterior wall of the stomach near the pylorus.

Jejunum. Beros¹⁹ reports 2 cases: 1 discovered at operation and the other at autopsy.

Ileum. In my study of 369 cases the ileum was the seat of perforation in 279, or in 75.60 per cent. of the cases.

Meckel's Diverticulum. Mauger notes the cases reported by Golton, Dreyfus, Delanglade, and also a personal communication from Heurteaux reporting the successful operation in a boy aged ten years. Long²⁰ also notes another successful case in a man aged twenty-five years. Goodall observed one case postmortem and Landis²¹ another similar case.

Cecum. Mauger notes the 8 cases reported by Leudet (3 cases), Rokitansky (2 cases), Milliard, Thompson, Herbert and Thurston. In my statistics are included 5 subsequent cases reported by: Bousset,²² male, aged twenty-two years; operation, death; Claybrook,²³ male, aged eight years, operation, recovery; Fontoynt,²⁴ male, aged twenty-two years, operation, death; Scott,²⁵ female, aged twenty-two years, operation, recovery; Haggard,²⁶ male, aged twenty-three years, operation, death.

The Vermiform Appendix. The limitation of the space at my disposal does not permit of a detailed consideration of the appendi-

¹⁴ Personal communication.

¹⁵ Jour. Amer. Med. Assoc., March 11, 1903.

¹⁶ La perforation typhique de l'intestin et de ses annexes, son traitement chirurgical, Thèse de Paris, 1900.

¹⁷ Il Policlin., 1905, tome xx, ses Prat., p. 157.

¹⁸ La Riforma med., 1908, xxiv, 487.

¹⁹ Contributions a l'etude des perforations intestinales chez les typhiques, Thèse de Bordeaux, 1906-1907.

²⁰ Surgery, Gynecology, and Obstetrics, 1907, iv, 301.

²¹ Personal communication.

²² Bull. méd., 1905, xix, 109.

²³ Personal communication.

²⁴ Bull. et mém. soc. de chir. de Paris, 1908, xxxiv, 701.

²⁵ Personal communication.

²⁶ Personal communication.

ceal complications of typhoid fever, which have been admirably described by Deaver,²⁷ Francois,²⁸ Frazier and Thomas,²⁹ Hopfenhausen,³⁰ Rolleston,³¹ and others. Briefly stated, it may be said that the appendix during typhoid fever may be the seat of any possible grade of inflammation, and that this may terminate in resolution or in the surgical calamities of perforation or pus formation. Deaver collected 40 cases of perforation, of which 7 were operated upon, with 4 deaths; the remaining 33 all died. I have collected 15 additional cases, all of which were operated upon, with 5 deaths—a mortality of 33.33 per cent. Deaver notes 41 cases of inflammation, of which 30 were subjected to operation, with 4 deaths; of the 10 cases not operated upon, 9 died. I have collected 22 additional cases, all of which were operated upon, with 4 deaths—a mortality of 18.18 per cent. In practically all of the inflammatory cases that recovered the operation was performed early in the disease. I agree with Deaver that during the height of the disease it is best not to operate, unless there is good evidence of perforation or pus formation.

Colon. Prevost-Maisonnay³² reports 2 cases, and in my analysis are included 12 subsequent cases.

Rectum. Mauger states that Leudet and Hutinel have each reported cases in which the rectum was the seat of a perforation. In 57 cases the anatomical location of the perforation was not stated.

SIZE AND NUMBER OF PERFORATIONS. The size of the hole in the intestine may vary from that of a pin point to that of a fifty cent piece, or larger. As a rule there is only one perforation, but there may be more. Scott³³ reports a case in which there were five, and in my study the perforations were multiple in 31 of the cases. As Selby³⁴ has emphasized, the leakage of the intestinal contents is of necessity in direct proportion to the size of the perforation.

SYMPTOMS. The symptoms of perforation should be divided into two classes: those occurring immediately at the time of perforation, and those later symptoms which are the result of it, or, in other words, those of the succeeding general peritonitis.

The symptoms of actual perforation may be either abrupt or gradual in their onset, and in a certain small number of the cases all leading symptoms are conspicuous by their absence. More commonly the onset is abrupt, and McPhedran³⁵ has observed that

²⁷ Appendicitis, etc., Philadelphia, 1905.

²⁸ L'appendicite au cours de la fièvre typhoïde, Paris, 1904.

²⁹ Univ. Penn. Med. Bull., July-August, 1907.

³⁰ Rev. med. de la suisse romande, 1899, xix, 105.

³¹ Lancet, May 29, 1898.

³² Lésions du colon dans la fièvre typhoïde, Thèse de Paris, 1899.

³³ Univ. Penn. Med. Bull., 1905, xviii, 81.

³⁴ AMER. JOUR. MED. SCI., 1908, cxxxv, 224.

³⁵ Canada Lancet, March, 1907.

the symptoms of perforation vary according to the situation which the perforated bowel occupies in the abdominal cavity—the nearer it lies to the centre of the abdomen the more fulminating will be the local and constitutional symptoms. It should be remembered that there is no pathognomonic symptom of perforation.

Martin³⁶ and McCrae³⁷ have each noted that while more or less abdominal pain may be present in the course of typhoid fever, the onset of sudden abdominal pain is a symptom of perforation of the first importance. As Manges³⁸ aptly states: "It is the constancy of the early occurrence of pain which makes it so important as a symptom of perforation." This pain varies in intensity and location; it is usually more or less localized to the lower right quadrant of the abdomen, or it may be referred to the umbilicus. As a rule it is a constant pain, becoming more intense at intervals. Pain that is localized at first but later becomes general throughout the abdomen, is an indication of a progressive general peritonitis. In cases of severe infection the apathetic, delirious, or comatose condition of the patient may entirely mask this subjective symptom, which, however, is prominent in fully three-quarters of the cases.

What has been described as the sudden classical fall of temperature in the light of our further knowledge, seems to be the exception rather than the rule. Scott states that a sudden rise of 1° or 2° followed by a slow but persistent fall to normal or subnormal over a period of eight to ten hours is more common, but in some few cases there is no appreciable change. The pulse rate usually rises rapidly; one of 140 beats per minute is not uncommon within twenty minutes after the time of perforation.

The two physical signs of the utmost importance that are usually present are tenderness and rigidity. The tenderness may be most marked at the point of pain, and this is accompanied by rigidity, usually more marked on the right than the left side in the beginning; with the onset of general peritonitis it is found in all the abdominal muscles.

So, too, the facial expression undergoes a change difficult of description; it is what the French have appropriately termed an "abattement," or weakening of the countenance, which, with the onset of general peritonitis, is replaced by the facies so characteristic of that disease.

Percussion of the abdomen may or may not aid in the diagnosis, for the normal liver dulness may have been obliterated previously by reason of intestinal distention. Manges, with an experience of 19 cases, states as his belief that it may be a sign of value if care be taken to watch daily any alteration in it.

³⁶ De la douleur abdominale dans la fièvre typhoïde, Thèse de Paris, 1901.

³⁷ New York Med. Jour., May 4, 1901.

³⁸ Jour. Amer. Med. Assoc., April 1, 1905.

The knowledge to be gained by an examination of the blood is as yet still a disputed point, save that as, Shattuck, Warren, and Cobb³⁹ have emphasized, an isolated count is valueless. Thayer⁴⁰ first showed the hypoleukocytosis of this disease, and Scott quotes Kast and Gutig, and Le Conte and Lewis as having drawn attention to the fact that in typhoid fever the onset of complications is not characterized by a leukocytosis. Differential counts have been believed by some to be an aid, but the whole question still remains to be settled. A rise in the blood pressure has been thought by Crile⁴¹ to be an indication of perforation, and from a study of 5 cases he concludes that there is a rise in the pressure after perforation to the same high level as occurs in peritonitis from other causes—a view that is shared by Sheppard,⁴² Rochester,⁴³ and others.

The symptoms of general peritonitis, the result of the perforation of a typhoid ulcer, are in no way different from those of a general peritonitis of different etiology. Their onset is usually to be observed in from four to six hours after the time of perforation, and presents a clinical picture so well known as to need no description here.

DIAGNOSIS. The ideal would be to make the diagnosis in what Cushing⁴⁴ calls the "pre-perforative stage;" but this period in the fulminant cases may be so short as to pass unnoticed as a clinical entity. It may be further obscured by the fact, as Killiani⁴⁵ has shown, that the perforation may involve other viscera, such as the gall-bladder, simultaneously with the intestine. Then, too, perforation may be simulated by other conditions: Miller⁴⁶ notes 2 cases of fecal impaction in children which gave the symptoms of an intra-abdominal calamity; Hall,⁴⁷ a case in which perforation was simulated after the administration of a medicinal dose of opium; Scudler,⁴⁸ a series of cases of mistaken diagnoses.

The space at my disposal does not permit of the consideration in detail of the differential diagnosis of perforation from hemorrhage, cholecystitis, suppurating mesenteric gland, and iliac or femoral thrombosis. While every effort should be made to make a correct diagnosis, too much emphasis cannot be laid upon the fact that all important is the recognition of the fact that some intra-abdominal calamity has occurred that demands immediate operative interference for its relief. Occasionally cases of perforation may recover without an operation; Miller⁴⁹ has noted such a case in which the perfo-

³⁹ Trans. Assoc. of Amer. Phys., 1900, xv, 82.

⁴⁰ Johns Hopkins Hospital Reports, 1894-1895, p. 83.

⁴¹ Jour. Amer. Med. Assoc., 1903, xl, 1292.

⁴² Lancet, 1907, i, 1293.

⁴³ Annals of Surgery, 1901, xxxiii, 544.

⁴⁴ Archiv. of Pediat., 1906, xxiii, 441.

⁴⁵ Jour. Amer. Med. Assoc., December 8, 1906.

⁴⁶ Boston Med. and Surg. Jour., July 18, 1907.

⁴⁷ Personal communication.

⁴⁸ Ibid., 1907, xlv, 38.

⁴⁹ Ibid., May 25, 1899.

ration became sealed by an adherent tag of omentum; Brown,⁵⁰ another similar case; Musser,⁵¹ a case in which a perforation of the ileum was closed by adhesion to the posterior wall of the bladder. Price⁵² states as his belief that the reports of recovery from perforation without operation are entirely too numerous to be true.

PROGNOSIS. The prognosis of necessity bears a distinct relation to the rapidity with which the diagnosis is made and operation performed, and to the bacteriology of the resulting peritonitis. As a general rule this is due to the colon bacillus, more rarely to the typhoid bacillus or to virulent organisms such as the streptococci. Vincent,⁵³ Flexner and Fraenkel,⁵⁴ Dalziel,⁵⁵ and others have all emphasized the fact that the streptococcic infections of the peritoneum are practically always fatal.

TREATMENT. An immediate operation should be the rule in all cases of perforation, unless the subject is dying. Occasionally patients have recovered that have been operated upon some time after the occurrence of the perforation: thus, Lauper⁵⁶ notes one on which he operated successfully fifty-eight hours after the perforation, and Moschowitz⁵⁷ another successful case, which came to operation three and one-half days after the apparent time of perforation.

As regards the anesthetic, there is a choice between local and general anesthesia. Local anesthesia has been used with success in some cases, but the use of ether would seem to be preferable, as it tends to diminish shock. It is all important that the operation should be speedily performed.

The more generally employed incision is that through the outer half of the right rectus muscle. As soon as the peritoneal cavity is opened a methodical search should be made for the perforation. The ileum should first be found and examined, as that is the most common location of the lesion.

The hole in the intestine may be treated either by suture, enterostomy, or resection. When closure can be accomplished without too great narrowing of the lumen of the bowel, Lembert sutures, preferably of silk, may be employed. It is a needless waste of time to excise the ulcer. In those cases in which the closure by suture is not practicable, enterostomy is indicated; the subsequent closure of the artificial anus is usually safely accomplished. This method was first proposed by Escher,⁵⁸ and has since been strongly advo-

⁵⁰ *Annals of Surgery*, March, 1903.

⁵¹ *Pennsylvania Medical Journal*, April, 1905.

⁵² *American Journal of Obstetrics*, 1907, lvi, 691.

⁵³ *Anal. de l'Institut Pasteur*, vii, 141.

⁵⁴ *Johns Hopkins Hospital Reports*, 1895.

⁵⁵ *Glasgow Medical Journal*, 1905, lxiv, 262.

⁵⁶ *Corbl. f. Schw. Aertze*, 1905, xxv, 74.

⁵⁷ *New York Med. Monat.*, 1904, xvi, 402.

⁵⁸ *Mitt. u. d. Grenzgeb. d. Med. u. Chir.*, 1903, xi, 4.

cated by Bartlett,⁵⁹ Hays,⁶⁰ and others. Anderson⁶¹ states that the toxemia from a paralyzed bowel is a big factor in the mortality of perforation cases, and that this is an indication for a drainage rather than a suture operation, a view that has been concurred in by Domela.⁶² The objection to the operation of resection is its great mortality. The peritoneal cavity should be flushed out with quantities of either hot salt solution or sterile water, and the operation completed by the introduction of drainage. Scott,⁶³ Blake,⁶⁴ and others, while insisting on the value of the Murphy method of enteroclysis, are opposed to the use of the Fowler position, as in their experience it has seemed to be productive of distinct harm. On the other hand, Hays,⁶⁵ who has had a large experience and very great success with his cases, states that he invariably employs it in an exaggerated form, the patient being placed almost upright in bed.

CONCLUSIONS. Too much stress cannot be laid upon the fact that all important is an early diagnosis and immediate operation. This would seem to be best attained by a close coöperation between physicians and surgeons, so that the latter, when the complication occurs, may not be at the disadvantage of not having seen the patient before. While typhoid fever in the past has been regarded as a disease belonging essentially to the realm of internal medicine, in the light of our further knowledge one may state that its relation to surgery is indeed most intimate. Holscher⁶⁶ studied the results of autopsies upon 2000 cases of typhoid fever and found that only 24 per cent. died from the fever per se, and the remaining 76 per cent. died as the result of the various sequels. Flexner⁶⁷ notes that in 80 per cent. of the cases of typhoid fever the bacillus can be shown in the blood of the patient during life; Busquet⁶⁸ has recently reported a series of 43 cases in which he noted it in the blood in pure culture.

That typhoid fever patients stand surgical interference well has been admirably illustrated by the case reported by Cushing, in which the patient was operated upon three times within two weeks: twice for perforation and once for intestinal obstruction from adhesions, and yet recovered. Scott⁶⁹ reports the case of a boy, aged eight years, who at operation presented two perforations of the ileum and a gangrenous and perforated appendix and still made a good recovery despite three relapses.

⁵⁹ *International Journal of Surgery*, 1904, xvii, 99.

⁶⁰ Personal communication.

⁶¹ *American Medicine*, December 31, 1904.

⁶² *Rev. de gynec. et de chir. abdom.*, 1905, ix, 623.

⁶³ *International Clinics*, viii, 21.

⁶⁴ *New York Medical Journal*, February 23, 1907.

⁶⁵ Personal communication.

⁶⁶ *Münch. med. Woch.*, 1891, xxxviii, 43.

⁶⁷ *Journal of Pathology and Bacteriology*, 1894, iii, 202.

⁶⁸ *La presse méd.*, 1902, p. 593.

⁶⁹ *University of Pennsylvania Medical Bulletin*, May-June, 1905.

SUMMARY OF STATISTICS.

Number of operative cases	369
Died	242
Mortality percentage	65.58

Age.

Under thirty-one years	249
Over thirty-one years	75
Not stated	45

Total 369

Youngest patient aged five years; oldest, aged sixty-five years.

	Cured.	Died.	Mortality percentage.
Children	37	31	45.58
Adults	75	178	70.03
Not stated	15	33	68.77
Total	127	242	65.58

Sex.

Males	281
Females	58
Not stated	30

Total 369

Location of the Perforation.

Stomach	1
Jejunum	1
Meckel's diverticulum	2
Ileum	279
Cecum	5
Appendix	15
Colon	12
Not stated	54
Total	369

*Perforation of the Appendix.**Sex.*

Males	9
Females	5
Not stated	1
Total	15

Results of Operation; Perforation of the Appendix.

	Cured.	Died.	Mortality percentage.
Adults	6	3	33.33
Children	4	0	..
Not stated	0	2	100.00
Total	10	5	33.33

Number of cases with multiple perforations 31
 Greatest number in a single case 5

Treatment of Perforation.

	Cured.	Died.	Mortality percentage.
Suture	108	223	70.38
Enterostomy	9	11	55.00
Resection	0	3	100.00
Appendectomy	10	5	33.33
Total	127	242	65.58

Cases of Inflammation of the Appendix Submitted to Operation.

	Cured.	Died.	Mortality percentage.
Adults	10	3	23.07
Children	4	1	20.00
Not stated	4	0	00.00
Total	18	4	18.18

SPASM OF THE CHEST MUSCLES, PARTICULARLY THE INTERCOSTALS, AS A PHYSICAL SIGN OF DISEASE OF THE LUNGS.

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MUSCLE rigidity has long been considered an important symptom in certain diseases, especially acute disease of the abdominal organs. This muscular spasm or rigidity varies in location according to the organ diseased; thus, if the appendix is inflamed, the rigidity is found in the right lower quadrant of the abdomen; if the gall bladder, in the right rectus; if gastric perforation or pancreatic disease be present, in the upper portion of the left rectus; and when general peritonitis is present, the abdominal muscles generally show rigidity. Spasm of the lumbar muscles is noticed in pyelonephritis, and spasm of muscles about the joints is an important symptom accompanying tuberculosis of the joints. So far, I have not been able to find mention of rigidity of the chest muscles as a sign of inflammation of the lungs. Musser¹ mentions the fact that spasm of the thoracic muscles occurs over the affected side in pleuritis, but does not mention its occurrence when the parenchyma of the lung is involved. Mackenzie² explains the sense of constriction experienced during attacks of angina pectoris as being due to spasm of the intercostal muscles through reflex stimulation.

In the examination of patients suffering from pulmonary tuberculosis, I have found this muscle rigidity, particularly as it affects the intercostal muscles, to be a constant sign. Not only have I been able to map out the areas of infection, but I have been able

¹ Medical Diagnosis.

² Diseases of the Heart.

to judge the nature of infiltration with a considerable degree of accuracy by the condition of the muscles, the rigidity being much greater over dense infiltrations than over infiltrations of less degree, and greater over recent inflammatory infiltrations than over old quiescent ones.

There is some question in my mind as to the exact explanation of these rigidities. It is easy enough to say that they are due to nerve irritation, but to trace accurately the paths through which the stimuli are conveyed is somewhat difficult; and the fact that the rigidity is so often confined to the muscles or even parts of muscles which immediately overlie the inflamed parts, seems to me to be unsatisfactorily explained by their nearness, and not explained at all by saying it is due to direct stimulation of the nerve trunks supplying the part, for other muscles or other parts of muscles supplied by the same nerve trunk as the muscle or portion of muscle which shows the rigidity, show none at all. A very good illustration of this is found in the rigidity in the upper portion of the left rectus in the presence of gastric perforation or acute pancreatitis. While the entire rectus is supplied by the lower intercostal nerves, the rigidity for the most part is confined to the upper portion of the muscle. It has been suggested that the areas showing greatest rigidity represent the fields of maximum response, but this fails to convey a clear, definite idea to the mind.

Neither can this be explained by the supposed and oft-repeated explanation of the rigidity of the abdominal muscles in the presence of acute inflammations of the abdominal organs: that it is Nature's method of protecting an inflamed part. This does not explain. It is simply a confession of ignorance in the guise of an explanation. It might be said with equal justice of the stiffness of an inflamed joint, and often is, that it is an illustration of the beneficence of Nature—that Nature has put the joint to rest in order to protect it; when the truth of the matter is that the stiffness is due to the products of inflammation being thrown out around and into the joint, and that it is an unavoidable condition without any respect whatever for the patient's welfare. In diseases of the chest such a supposed explanation falls of its own account; for what extra protection could the intercostals and other chest muscles give to the inflamed organs in the thorax over and above that furnished by the bony cage in which they are placed? It seems more probable that there is some direct nerve connection, perhaps of developmental origin, between the underlying organs and the special branch of the nerve which supplies the muscles overlying them, whereby impulses may travel without stimulating other muscles supplied by the same general nerve trunk. If this be true, we can see that while all the abdominal muscles are supplied by the lower intercostal nerves, and all the abdominal viscera are supplied by the sympathetic system, yet an appendicitis can stimulate the muscles in the lower right

quadrant of the abdomen, and pancreatitis the upper half of the left rectus, without stimulating the abdominal muscles in general, and an inflamed area in the lung or pleura might cause a spasm of the overlying muscles without stimulating all the muscles supplied by the same nerve trunk.

It may be argued that the rigidity of the intercostal muscles that I have in mind is the same as has been described heretofore as due to pleuritis; but there are certain facts which speak against this. There is a rigidity that can be noticed over pleuritis, but it differs in degree from that noted when there is inflammation of the parenchyma of the lung. In the latter instance there is a much greater resistance, the degree agreeing very accurately with the percussion findings. The analogy of the abdominal conditions, which are accompanied by muscle rigidity, also speaks against the involvement of the underlying pleura as a necessary cause of the rigidity. In appendicitis the rigidity of the abdominal muscles is present when the inflammation is confined to the organ itself and the parietal peritoneum is free from disease. The same is true in gall-bladder disease and pancreatitis; so that it seems that inflammation of a contiguous part is not necessary to produce these muscular spasms.

The intercostal rigidity must not be confused with the feeling of resistance found over non-air-containing organs like the liver and heart. These organs can be outlined with more or less accuracy by palpating the intercostal spaces, but the sense conveyed to the touch over the heart or liver is very different from that experienced on palpating the rigid intercostals over pulmonary infiltrations.

That this is a true muscle spasm, and not dependent upon the thickness of the muscles themselves, can be easily determined by careful observation: if when examining a patient with pulmonary tuberculosis the examiner will carefully palpate the intercostal spaces, he will notice different degrees of rigidity over different areas of lung tissue; but allowing for the different thickness of the muscles and overlying tissues, it is still evident that the difference noticed by the touch is due to the condition of the muscles themselves and not to the thickness of the tissues.

While rigidity affects all the muscles of the chest, yet it is found in greatest degree in the intercostals. Rigidity in the superficial muscles may be detected by picking them up and rolling them between the thumb and fingers, when it shows as an increased firmness. In some instances the rigidity is so marked that it can be easily detected by the sense of firmness to the touch as compared with the softness of the muscles over healthy tissues. While the rigidity of the superficial muscles is at times very marked, yet I have found that of the intercostals of greatest value in diagnosis, except at the apices where the mass of muscles covering the superior aperture of the thorax may be relied upon.

In some instances not only are the motor nerves affected, but the sensory nerves also, in which cases the overlying skin is hyper-sensitive. Patients so affected often complain of pain when the skin is touched, and they are especially sensitive to the percussion strokes. This is often considered a nervous manifestation and ignored, but we have every reason to believe that it is painful.

What has seemed to me to be the best method of detecting the intercostal rigidity is a systematic palpation of the intercostal spaces, beginning at the lowest and comparing the rigidity of each space with the one above and also with the corresponding space on the other side. A little practice will soon show the examiner that he must allow something for the natural increased resistance over the heart and liver and also over thick muscles, such as the pectorals. The palpation is best done by gently pressing the tips of the fingers into the intercostal spaces and moving the hand sidewise while noting the degree of resistance. During this procedure the fingers should not be allowed to slip on the skin, for it is the condition of the muscle and not of the skin that is to be noted.

In examining many advanced cases of pulmonary tuberculosis, I have found that when the tissues break down and form a superficial cavity the resistance which was formerly noted disappears. I cannot believe that this indicates that the muscle rigidity has disappeared, for I believe this is more or less permanent. The explanation which seems to me probable is that the disappearance of resistance is due to the removal of the densely infiltrated tissues which have previously furnished support for the intercostals. That it is not due to a disappearance of the muscular spasm is supported by the fact that the rigidity does not disappear (at least not always) in old lesions, as, for example, in the instance mentioned later, in which the rigidity was found twenty-four years after the history of acute symptoms.

Not only does this spasm of the chest muscles bid fair to be an important physical sign in itself, but it helps to explain other well-recognized signs: lagging on the affected side, contraction of the chest wall, ankylosis of the costosternal articulation, diminution of the respiratory murmur, and the harsh, impaired respiratory note. It is obvious that spasm of the chest muscles must interfere with the free movement of the ribs, thus limiting the motion on the affected side and interfering with the normal expansion of the lung. We have been of the opinion that lagging is due to an interference with the normal elasticity of the lung tissue, owing to the presence of tubercles; but it seems that this muscular spasm adds another important and perhaps even greater factor. The connection between lagging and muscular spasm raises the question of the earliness in the disease in which this sign appears. Lagging is one of the most constant as well as one of the earliest signs noted in pulmonary tuberculosis. It is found before the presence of rales, when the

only changes found upon auscultation are so slight that they can be detected only by the most careful examination; and it remains throughout the disease. So far I have been able to detect muscle rigidity above the clavicle and spine of the scapula, or in the first intercostal space in every early case that I have examined. While the number is too small to warrant a general conclusion, yet this indicates that the sign comes very early in the disease, and, of course, this is what we should expect. It is much more difficult to detect in these slight infections, and requires more skill and more care on the part of the examiner. How long it persists after activity ceases remains to be determined. Recently I had an opportunity to examine a man who had not had any active symptoms in the lung, as far as could be determined from his history, for twenty-four years, but I was able to outline his former trouble by the rigidity of the intercostals. Very marked lagging was present over the area which had been diseased. Percussion and auscultation proved the accuracy of the findings on palpation. While more observations are desirable before giving an opinion, this indicates that the sign is not an indication of active disease, but that it points to the fact that the underlying tissues are or have been diseased. While the intercostal muscles are not very large, and while their contractile power is not very great, yet it is evident that their constant contraction, reinforced by the less degree of contraction of the more superficial chest muscles, must have a tendency to lessen the thoracic space, thus causing the contraction or flattening which is so common in chronic pulmonary conditions. This same interference with motion of the ribs hinders expansion of the lungs and helps cause the auscultatory phenomena mentioned above.

The fact that this rigidity remains so long and is so constant needs explanation. It is contrary to the teachings of physiology that a muscle should remain in a constant state of contraction; sooner or later the contractile power is overcome, and relaxation ensues. That this does not occur in old lesions indicates that there is probably some pathological change, perhaps a fibrous degeneration which takes place in the muscles which preserves their rigidity.

A new physical sign is of no special importance beyond the scientific interest attached to it, unless it is a distinct aid to diagnosis. This, I believe, intercostal rigidity to be. Modern advances in diagnosis of diseases of the chest have had a tendency to belittle the value of physical examination. So many men had realized the difficulty of making accurate diagnoses by the usual physical examinations that when the microscope proved its value in diagnosing tuberculosis they ceased making careful physical examinations and depended almost entirely on the microscopic findings. The tuberculin test as administered today hypodermically, by the skin and conjunctiva, will have a tendency further to discourage careful

physical examination. This is greatly to be deplored, for approximately accurate diagnoses of pulmonary conditions can be made only after careful physical examination.

I hope that this sign may be of value, but I would add one word of caution as to technique: that is, not to lay the fingers flat on the chest, but to palpate with the ends of the fingers gently pressed into the intercostal spaces. The examiner will often be confused when pleuritis exists, for, as mentioned above, pleuritis produces a rigidity, but this can be excluded by other methods. It will also be difficult to interpret at times in chests which have been the seat of many and varied changes, such as we find in far advanced tuberculosis. But in these instances it is not different from other methods of physical examination, for they all fail us under such conditions. A little experience will show one its worth and also its limitations.

GASTRIC DIGESTION IN INFANTS.

A REVIEW OF THE LITERATURE.

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THE investigations into the chemical and physiological processes which go on in the stomach of the human infant during the progress of digestion, may be divided chronologically into two groups: investigations before and after the introduction of the stomach tube. The studies of the first period were few and of but little value; they consisted in investigations on the lower animals and upon the cadaver of the human infant. The objections to the first of these methods depend upon the facts that at birth the digestion of the lower animal is in a more advanced state of maturity than is the case in the human being, and develops much more rapidly to the adult type, so that one is not justified in drawing absolute conclusions from animal experiments. The study of the stomach and gastric contents of the dead baby are open to the fallacies that whatever causes the death may markedly alter the constitution of the gastric juice, the condition being rather pathological than physiological, and that the gastric mucous membrane degenerates so rapidly after life has ceased that the state at autopsy may be markedly different from that occurring during life. However, one or two observations were made during this period which are of some interest, the most important being the finding by Zweifel,¹ in 1874,

¹ Untersuchungen über den Verdauungsapparat der Neugeborenen, 1874.

of an acid in an extract of the gastric mucous membrane of a still-born child, the nature of which, however, he was unable to determine; and by Langendorff,² in 1879, of pepsin in a three months' foetus. He could not, however, find acid in a foetus of six months.

The studies of real value, however, have been made by the use of the stomach tube. This instrument, though first introduced into medicine by Kussmaul,³ in 1867, for the study of the contents of the stomach of the adult, was not used for children until many years later, when Epstein,⁴ in 1880 and again in 1883, published papers describing the ease with which a small rubber catheter could be passed into the stomach of even the youngest infant, and strongly recommended lavage as a therapeutic measure in the gastro-intestinal diseases of infancy. He, however, did not attempt any examination of the contents, and to Raudnitz,⁵ in 1887, twenty years after Kussmaul's first use of the tube on the adult, belongs the credit of first having made a chemical examination of the gastric contents of an infant by the use of the stomach tube. This author, however, examined but seven cases, and these for the rennin action only, so that the credit of the first systematic chemical investigation belongs to Leo,⁶ who in 1888 published his report of the study of 134 cases. The following year von Puteran,⁷ in St. Petersburg, reported 1027 examinations on 248 healthy children under six weeks of age. These papers aroused much interest, and during the next two years seven papers appeared, covering various aspects of the subject. Since then each year or so some new publication has appeared adding more or less to our knowledge. The subject may be considered under four headings: motility, acidity, pepsin digestion, and rennin coagulation.

MOTILITY. The subject of the motility of the infant stomach has been studied by two methods, the length of time that it takes the organ to empty itself, and the number of minutes after a meal before food appears in the intestines. In Epstein's original article, though he made no chemical examination of the stomach contents, he did note the average time which food remained in the stomach, and stated that in healthy breast-fed children, food could be found from an hour to an hour and a half after a meal, while in children suffering from gastro-enteritis it remained from two to five hours. Leo in 1888 elicited the following facts: With breast-fed children of less than a week old, the stomach is often empty in one hour, while during the first month the maximum duration of the food in the stomach is one and one half hours. With older children, and children fed on cows' milk, it remains from one and a half to two hours. He agreed with Epstein that in disease the time is much longer, and in one case he found a considerable quantity after seven

² Archiv f. Anat. und Physiologie, 1879.

⁴ Arch. f. Kindh., vol. iv.

⁶ Berl. klin. Woch., 1880, xxv, 980.

³ Prag. med. Woch., 1880.

⁵ Prag. med. Woch., 1887, No. 24.

⁷ Thesis, St. Petersburg, 1889.

and a quarter hours. Leo further showed that the stomach is never entirely empty, but that some time after the last traces of food have disappeared a few drops of a thick yellowish fluid could be obtained by the stomach tube. This fluid contained all the elements of gastric juice in a very concentrated form. To prove whether this was due to further secretion, or was the remains of the last meal, Leo washed several stomachs quite clean, and then passed the tube again a half-hour later. The fluid then obtained was neutral, and consisted apparently merely of a little of the wash water. From this he inferred that no secretion occurred in the empty stomach, and that the fluid formed therein was gastric juice remaining from the last meal, concentrated by the absorption of the water.

Von Puteran, in 1889, in his 248 breast-fed children under six weeks of age found the stomach practically empty in seventy minutes in 3 per cent. of his cases, in ninety minutes in 30 per cent., and in two hours in 95 per cent. He could, however, find traces of food as late as two and one-half hours after the last meal.

Einhorn,⁸ in 1889, studied the effect of various foods upon digestion, his method being to wash the stomach on alternate days, one day in one and one-half hours and the other in two hours. On a diet of breast milk he found the stomach always empty in two hours. He was unable to repeat this at an earlier hour, as the mothers objected to the procedure. On a diet of cows' milk and water, and cows' milk and barley water, the stomach emptied itself in from one and a quarter to two hours, while on various artificial foods, including Carnack's, Nestle's, and Mellin's foods, and malted milk, considerable quantities remained after two hours.

Cassel,⁹ in 1890, confirmed the finding of Epstein and Leo in regard to the long duration of food in illnesses. He studied seven children from four weeks to eight months of age suffering from marasmus, and found that it took from four to six hours to complete the gastric digestion.

Czerny¹⁰ added one more fact to our knowledge in 1893, by showing that while a child fed on breast milk every four hours emptied his stomach in from one to one and a half hours, if two or three feedings were given at intervals of an hour, food could be found in the stomach after the last feeding for a much longer period. From this he inferred that the stomach, like the other organs of the body, required periods of rest properly to fulfil its function.

Pfaumersill,¹¹ in 1893, made the first observation on the time required for food to appear in the intestines. For this purpose he used the common salol test, giving the child salol mixed with its

⁸ New York Med. Jour., 1889, p. 67.

¹⁰ Prag. med. Woch., 1893, p. 495.

⁹ Arch. f. Kindh., 1890, xii, 175.

¹¹ Jahrb. f. Kindh., xxxv, 369.

food. He passed a catheter on the infant and left it in situ, testing the urine every five minutes with ferric chloride. By this procedure he obtained the iron reaction in from forty to sixty minutes in sixty healthy and twenty-seven ill children. In the healthy children the reaction continued for from twenty-four to twenty-six hours, while with the ill children it lasted much longer, even up to one hundred and forty-four hours in one case.

Hecker,¹² in 1900, by the same method found that the appearance of the reaction in the urine varied with the age of the patient. In children from one to three years old it averaged forty-five minutes; from three to five, fifty-eight minutes; from six to ten, seventy-three minutes.

ACIDITY. The first study of the acidity of the infant's stomach contents was made by Leo, in 1888, who investigated thirty healthy children on various diets, between two hours and twelve months of age, and one hundred and four children suffering from gastro-intestinal diseases. He found that the reaction of the stomach contents to litmus immediately after a meal was the same as that of the ingested food, that in fifteen minutes it was weakly acid, and that the acidity increased steadily during the period of digestion. He was unable, however, to detect the presence of free hydrochloric acid until an hour or more had elapsed; on the other hand the empty stomach always contained the free acid. In two newborn children, before any food had been taken, a small amount of brown bloody fluid was obtained which was strongly acid and contained free HCl, whereas the reaction of the amniotic fluid is alkaline. In his cases suffering from gastro-intestinal diseases, the contents also were acid, and often highly so, containing besides the hydrochloric, butyric, acetic, and lactic acids. This high acidity, and especially the presence of the large amounts of hydrochloric acid, Leo laid not to a hypersecretion, but to the long continuance of the food in the stomach. He then described for the first time what he called the "binding power" of milk for hydrochloric acid. He showed that considerable amounts of hydrochloric acid must be added to a neutral or amphoteric milk before any reaction for the free acid could be obtained. By this he explained the fact that the acid does not appear in a free state until so late in digestion, so that it would not show itself until after the milk had become saturated with it.

Van Puteran in his investigations on breast-fed babies under six weeks of age confirmed the steady increase of total acidity during digestion varying from 0.3 per cent. in ten minutes to 0.8 per cent. in ninety minutes. In his cases he never found fatty acids, and lactic acid only once.

Einhorn showed that the total acidity was variable, but in general

lower in children fed on mothers' milk than in those on cows' milk or artificial foods. He found lactic acid in most of his cases, and free hydrochloric acid only once in fifty examinations.

Von Jaksch,¹³ in 1890, published a paper in which he differed from the previous authors in finding free hydrochloric acid in fifteen minutes to the amount of 0.08 per cent., in thirty minutes 2.4 per cent., and in one hour 2.9 per cent. His method was to take 10 c.c. of the stomach contents and to this add an excess of BaCO_3 . This he evaporated on the water bath in a platinum dish, dried and heated to a red glow over the free flame. The residue was then taken up in water, boiled and filtered. The BaCl_2 so formed went into solution, while the BaCO_3 , formed from the organic acids, remained on the filter. The barium in the filtrate was then estimated as BaSO_4 and the amount of chlorides calculated. It is evident that by this method von Jaksch obtained not only the free hydrochloric acid, but also the acid which was bound to the casein, and his figures represent the free plus the bound HCl.

Cassel in his marasmus cases found free HCl in about half of the patients, and confirmed Leo's finding of butyric acid.

Pipping¹⁴ writing from Finland, in 1891, reported investigations on twenty-nine healthy children under three months, and twenty-five others suffering from gastro-intestinal troubles, and gives the following findings: In healthy breast-fed children, he in no case found either lactic or butyric acid. In healthy children fed on cows' milk, lactic acid occurred in about one-half of the cases and the fatty acids in all. In the ill children on mothers' milk, lactic acid was present in three-fourths of the cases and fatty acids in one-fourth, while in ill children on cows' milk, lactic acid occurred in none, but the fatty acids in two cases in which examinations were made.

Heubner,¹⁵ in 1891, examined forty babies of various ages and on various diets, with especial reference to the forms of acids found in the stomach. His method was to wash the stomach clean with distilled water. This wash water was then distilled, and the distillate titrated for the volatile fatty acids. The residue was shaken with ether and the ether titrated for lactic acid. He tested for the free hydrochloric acid by using phloroglucin-vanillin, and Congo red as indicators. By this method he found volatile acids in about one-half of the twenty-six cases in which they were looked for, and in measurable quantities in five of them. Lactic acid could be demonstrated in all cases which were on a milk diet. As to free hydrochloric acid, in the twenty-six cases in which enough material was obtained for a quantitative estimation, it was found in measur-

¹³ Ztschr. f. klin. Med., xvii, 382.

¹⁴ Jahrb. f. Kindh., 1891, xxxii, 27

¹⁵ Thesis, Helsingfors, 1891.

able amounts in two cases, and in traces in four others. In the cases in which the meal had remained longer in the stomach, in which the small amount of material allowed qualitative examination only, it was positive for free HCl in one-half of the cases. Heubner then took up Leo's binding power of milk and found that 100 c.c. of cows' milk would absorb 0.324 gram of HCl before a reaction for this free acid appeared, whereas woman's milk would absorb only about half that amount.

In the same year Wohlman¹⁶ in a series of experiments came to the conclusion that if the stomach was washed out previous to the giving of the food, and then examined in one and a half hours, the amount of HCl was increased on an average of 85 per cent. over that found when no previous lavage had been done. This he thought was due to the irritation of the mucous membrane stimulating an increased secretion. He further found that in indigestion the HCl increased in amount during digestion, but at a slower rate than in health. In prematurely born children he could find no free HCl at any time. A tea diet gave the presence of free HCl at an earlier hour than a milk diet.

Clopatt,¹⁷ 1892, and Henri and Marcel Labbé,¹⁸ 1897, first made use of the method of Havem and Winter to estimate not only the total acidity and the free HCl, but also the total chlorides, fixed chlorides, and organically bound chlorides. Their results were not very striking, Clopatt saying that he could find no relation between the acidity and the age of the child or the time the food remained in the stomach. The Labbés, on the other hand, found the total acidity to be very feeble at birth, to increase rapidly during the first month of life, and then more slowly afterward.

In 1898 Bauer and Deutch,¹⁹ in Budapest, studied the occurrence of free HCl in various diseases. Their most interesting findings relate to pneumonia and diphtheria. They found that if the stomach contents was removed in from one and a half to two hours after a meal during the febrile period of pneumonia, no free acid could be found, whereas immediately after the crisis it reappeared. In diphtheria, during the attack, the free acid disappeared, and in cases which recovered without the use of antitoxin, did not reappear until about the third week. In cases also in which serum was used, but the patient died, the free acid never returned, while in these cases in which the use of antitoxin was to be followed by recovery, the acid returned to the stomach in from twenty-four to forty-eight hours after the injection.

Meyer,²⁰ Copenhagen, in 1903, published an extensive piece of work, in which he recommended the use of a constant test meal in studying infant digestion, and advised the use of barley water as

¹⁶ *Jahrb. f. Kindh.*, 1891, xxxii, 297.

¹⁷ *Revue de méd.*, 1892, p. 249.

¹⁸ *Revue mens. des malades des enfants*, 1897, p. 401.

¹⁹ *Jahrb. f. Kindh.*, 1898, xlviii, 22.

²⁰ *Arch. f. Kindh.*, xxxv, 79.

being of especial value, as by its use neither lactic nor butyric acid is formed, so the HCl secretion can better be studied. He differed with Wohlman's statement that lavage previous to the giving of the meal increases the amount of acid secretion. In his series of cases, in which lavage was performed a half hour before the meal, no such increase occurred. Meyer found that while there was a general progressive increase in acidity during digestion, very marked variations occurred from day to day in the same child on the same diet, due, he thinks, to a neurotic influence. The highest total acidity which he could find on barley water diet was 0.9 per cent., on distilled water 0.8 per cent., while on cows' milk it went much higher, even to 2.58 per cent. in one case. In cases of acute and chronic gastritis on the barley water diet he found the acidity to be below normal, while neither lactic nor butyric acid could be found.

The paper of Hamberger and Šperck,²¹ which appeared from Escherich's clinic in Vienna, in 1905, is of interest, as all their subjects were under two weeks of age, and were fed on mothers' milk. They agreed with the increase in amount of free HCl during digestion, finding it present at the end of one hour in 10 per cent. of the cases, in one and a quarter hours in 33 per cent., and in two and a half hours in 50 per cent. In these very young infants they never found lactic or butyric acid present. They lay much stress upon what they call the hydrochloric acid deficiency of the stomach contents.

Following Sjöquist's findings, that it is the hydrochloric acid only which is bound to the protein that acts in peptic digestion, and that the appearance of free HCl signifies that enough has appeared to carry on the digestive process to its completion, they argue that it is of importance to know how far the contents are below the point of complete saturation with the acid. To decide this they added decinormal acid until it showed free in the contents. The amount required they called "hydrochloric acid deficiency of the contents." They then said that the "hydrochloric acid binding power" of the material was equal to the total acidity plus the hydrochloric acid deficiency, or if free acid is present, the total acidity minus the free acid. They then stated that a priori one would expect the binding power of the contents to be less than that of the food ingested, due to its dilution by the gastric juice. This, however, does not occur, 100 c.c. of breast milk having a binding power for 60 c.c. $\frac{n}{10}$ HCl, while the stomach contents has a binding power of 80 c.c. To explain this they offer two hypotheses: one, that the hydrolytic splitting of the protein enables the larger number of molecules to take up more acid (this they discard, as they say it does not occur in artificial digestion), and the other, that the increased binding power is due to a greater concentration of

²¹ Jahrb. f. Kindh., 1905, lxii, 495.

the stomach contents by the absorption of water. If it is due to the withdrawal of water alone, one would expect a concentration of the insoluble elements of the stomach contents, that is, the coagulated albumin, and as most of the fat is imprisoned in the coagulum, an increase in the concentration of fat. Then too the sugar should be in a stronger solution. The percentage of sugar, however, is found to be decreased, and that of the fat is unchanged. They therefore, infer that the increased HCl binding power is due neither to protein splitting nor to concentration of the contents, but to the secretion of acid salts and weak organic acids, and possibility to the formation of fatty acids by a fat-splitting enzyme in the stomach.

Sedgewick,²² of Minneapolis, working in Heubner's clinic in Berlin, in 1906, made a study of the occurrence of a fat-splitting enzyme in the stomach contents of infants and newborn rabbits, from which he drew the following conclusions: (1) A fat-splitting enzyme occurs in the stomach of the infant; (2) it appears early in the first twenty-four hours in the rabbit, and as early as the second week in the infant; (3) it can reach as high a grade as in the adult; and (4) this can explain a part of the acidity of the stomach contents.

Miller and Willeox,²³ in London, published some results in 1907, according to which they divide "wasted infants" into three classes: (1) Simple marasmus or atrophic dyspepsia, with a reduction in the acidity and pepsin content; (2) hypertrophic stenosis, in which the acid content is also low; and (3) acid dyspepsia or pylorospasm, in which the acid content is high.

The most recent addition to the knowledge of the gastric contents of the infant comes from the clinic of Prof. Schlossmann, in a work by Engel.²⁴ This author investigated the gastric secretion in an infant, aged five weeks, who was suffering from pylorospasm, upon whom a jejunal fistula had been made, through which the child was fed. By passing the stomach tube he obtained pure gastric juice. He estimated that from 100 to 200 c.c. of gastric juice was secreted daily, and that it differed very slightly in acid and pepsin content from the gastric contents of the adult. The figure which he gives for the free hydrochloric acid (0.257 per cent.), while not differing markedly from the normal in the adult, constitutes a very marked hyperchlorhydria for an infant of this age. This agrees with the cases of Knobfelmacher,²⁵ in which pylorospasm was accompanied by marked hyperchlorhydria.

PROTEIN DIGESTION. Escherich, in the early days of the study of the digestive action of the stomach of the infant, made the statement that the organ was practically inactive as a digestive organ, and acted merely as a reservoir, or holder of food, while the entire digestion of milk occurred in the intestines. Most of the investiga-

²² *Jahrb. f. Kindh.*, 1906, lxiv, 194.

²⁴ *Archiv f. Kindh.*, 1908, xlix, p. 16.

²³ *Lancet*, 1907, ii, 1670.

²⁵ *Wien. klin. Woch.*, 1900, p. 1188.

tions on protein digestion have been undertaken to disprove this statement. Leo was the first to prove that a protein splitting enzyme was present in the infant stomach, though he found that usually more acid had to be added, in order to enable the digestion to go on to any extent. He made two series of experiments. In the first he divided the material into two parts, one saturated immediately with ammonium sulphate; the other after twenty-four hours in the thermostat. He found very little difference between the amount of precipitate in the two cases, showing that for the amount of acid in the child's stomach, the peptic digestion was nearly complete at the time the meal was taken out. Addition of more acid enabled the proteolysis to go farther. He then investigated the stomach contents at different times during digestion. The specimen was first saturated with sodium chloride to remove what at that time was known as the primary propeptone. The filtrate from this was acidified to throw down the secondary propeptone, and the filtrate from this with phosphotungstic acid to get the peptone. Leo found by this method that a half hour after a meal there was an increase in the amount of albumoses, while peptones were present in traces only, whereas in an hour there appeared a marked increase of the secondary propeptone and peptones.

Van Puteran by a similar method showed that in his young breast-fed infants native albumin could rarely be found one hour after a meal, while peptone appeared in fifteen minutes. Cassel found that, if acidified, the stomach contents of his marasmus cases would always digest a flake of blood fibrin, even in the worst cases.

Toch,²⁶ in 1893, made an extensive study on two healthy and five ill children, and found peptone in all the cases. He then discussed the source of the peptone and said it must be produced from the casein by one of three actions: peptic digestion, hydrolysis by rennin, or the action of bacteria.

To determine which of these was the active agent, he performed the following experiments. He placed a piece of blood fibrin in a few cubic centimeters of freshly removed stomach contents and allowed it to stand in a thermostat for some hours. The fibrin remained unchanged; another piece placed in the same amount of contents, which had previously been acidified, was digested in a few hours. He therefore said that though pepsin was present in the stomach, it did not act in the absence of free acids, and as none of his cases showed the presence of the free acid, the peptone found in their stomachs could not have been produced by the action of the pepsin. To determine that the digestion was not due to bacteria, he shook some contents with chloroform water, which he proved made it sterile, and to this added fibrin. The results were the same: without acid, no action; with acid, complete digestion. By this

²⁶ Arch. f. Kindh., 1894, xvi.

means he threw out the bacterial action. His third experiment consisted of placing specimens of cows' milk and mothers' milk in test tubes and adding rennin to them. After some hours at body temperature peptones were found in all the specimens. Toch, therefore, concluded that the peptone in the stomach of the infant could not be the result of peptic digestion or bacterial action, but must have been formed by the rennin. He had apparently completely overlooked the communication of Pipping two years before, which showed that free hydrochloric acid was not necessary for peptic digestion, that bound to the protein acting quite as well. In the light of the finding his elaborate reasoning becomes thoroughly worthless.

A recent and accurate effort at a quantitative estimation of protein digestion in the infant stomach is that of Leo Langstein,²⁷ assistant to Professor Heubner, who, in 1905, made a study of the gastric contents of several healthy children. His method was to wash the stomach clean with a liter or so of distilled water. One part of this wash water he acidified and boiled to remove the albumin. A second part he saturated with zinc sulphate to remove the albumin and all fractions except the peptones. In aliquot parts of the filtrates from these two precipitates he estimated the nitrogen by the Kjeldahl method. He found that in his cases the nitrogen in the form of proteoses varied from 0.012 to 0.040, while that as peptone and residual nitrogen from 0.003 to 0.017. He tested all his specimens for the amino acids, but was never able to find them present. Langstein then referred to the work of Rotundi, in 1903, which proved that the protein fractions produced by the action of rennin on milk were those of the more complex structure only, and stood somewhere between native proteins and primary proteoses, and that by the enzyme peptones were never formed. Langstein took these facts as conclusive proof that the peptones formed in the infant's stomach were produced by pepsin digestion.

The first use of the new methods of pepsin estimation upon the gastric secretion of the infant was made by Rosenstern²⁸ in 1908, who used the ricin method proposed by Jacobi. He reached the following conclusions: The quantity of pepsin in the healthy artificially fed infant increases during the first four months of life, and then remains constant; healthy breast-fed infants appear to produce less pepsin than artificially fed infants of the same age; in children who are under weight the quantity of pepsin is in accord with the age, not the weight; diseases of digestion do not influence the pepsin secretion noticeably.

Reeves Ramsay,²⁹ working in Heubner's clinic, has recently pub-

²⁷ Jahrb. f. Kindh., 1906, lxiv, 139.

²⁸ Jahrb. f. Kindh., 1908, p. 191.

²⁸ Berl. klin. Woch., 1908, xlv, p. 542

lished the results of a study from which he concludes: (1) Pepsin is always present in the stomach of normal breast-fed infants; (2) pepsin is usually present in the stomach of nurslings suffering from acute digestive disorders; (3) pepsin and HCl are present in increased quantities in cases of pylorospasm; (4) pepsin is frequently absent in cases suffering from chronic atrophy; (5) pepsin reappears when these cases begin to improve; (6) the gastric juice of a normal child can convert protein into peptone without the addition of acid; (7) pepsin in the gastric juice is active in promoting digestion without the presence of HCl or lactic acid; and (8) HCl and lactic acid may be present in the stomach, with an absence of pepsin, and vice versa.

RENNIN COAGULATION. The investigations on rennin coagulation were inaugurated by Raudnitz in 1887, in his original work on the chemical examination of the stomach contents in the infant. He reports seven cases only, four between the age of one and seven days, and three from two to six months. He neutralized the entire gastric contents with sodium hydroxide, and to it added 50 c.c. of cows' milk. In his cases, in the first week of life, he obtained no coagulation, while in the older cases he always found it. Leo differed from him, finding rennin activity in the newborn as well as older children. Von Puteran in his long series of cases under six weeks, by adding 25 c.c. of cows' milk to 5 c.c. of the contents and keeping it at 40° C. for half an hour, could get no rennin coagulation in children under twenty-four days of age, while he always found the enzyme active after the thirtieth day of life. Sydelowski,³⁰ in 1892, agreed with Leo's findings that rennin could be demonstrated in the newborn and at all ages. He further found that the empty stomach contained it, as did the stomach in cases of marked marasmus, and finally Hamberger and Spereck report it present in all of their cases in the first week of life.

RESUME. From these various investigations it will be seen that many and contradictory results have been obtained; a few facts, however, seem to be pretty definitely proved. In the first place, it may be said that all the factors present in the adult are found in a weaker form in the young infant. In the newborn child on breast milk the stomach usually empties itself in from an hour to an hour and a half; as the child grows older this time becomes longer. The few drops of gastric juice found in the empty stomach are the remains of that secreted during the last meal, and are not due to a secretion into the empty stomach. The motility is more rapid in breast-fed children than in those on cows' milk or artificial food, and more rapid in the healthy than in the ill child.

³⁰ *Jahrb. f. Kindh.*, xxxiv, 612. Other articles not referred to in the text are: Wolff and Freedjung, *Arch. für Kindrh.*, xxv, 161; Thiercelin, Paris, Thèse, 1894; Morcorvo, Paris, Thèse, 1889; and François, Paris, Thèse, 1907.

The acidity immediately after a meal is nil, but steadily increases during digestion, and is less in the very young than in the older. On a barley water diet free hydrochloric acid appears in the stomach in a few minutes, but on a milk diet it does not show itself for an hour or more, due to the fact that the casein absorbs it or combines with it in some way, and the free acid does not appear until the casein has taken up all required for its complete digestion. The free acid appears later in disease than in health, due to the increased amount of food in the stomach and to the slower secretion of the acid; in cases of pylorospasm the acidity is increased. Opinions differ as to the occurrence of lactic and volatile fatty acids, but these probably do not occur in healthy breast-fed infants, while in those ill or on cows' milk they are fairly common. Part of the acidity is probably due to a fat-splitting enzyme in the infant's stomach.

Pepsin is present at all ages and in all kinds of health, and acts in the infant stomach though to a less degree than in the adult. The peptic digestion goes on to the stage of peptones, but not beyond that. The fact that the stomach contents will not digest fibrin in the thermostat is due to the fact that all the hydrochloric acid is combined with the casein, and while the protein with which it is combined will be acted upon by the pepsin, a foreign protein without the addition of more acid will resist the enzyme.

Rennin occurs in the stomach after the first few weeks of life; whether during the first week is a moot question.

SYPHILIS OF THE STOMACH AND INTESTINES.

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SYPHILIS of the stomach, next to tuberculosis, the rarest of stomach diseases, was first described by Andral¹ in 1834. Since then, however, a number of cases have been reported, but the number of authenticated cases is still very small. Chiari,² for example, in 243 autopsies on syphilitic subjects, found only 2 undoubted cases of stomach syphilis. Stolper³ and Fraenkel⁴ report similarly to Chiari, but Aristoff,⁵ on the other hand, maintains that careful histological

¹ Clinique médicale, Paris, 1834, ii, 201.

² Internat. Beit. z. Wiss. Med., Festschrift für R. Virchow, Berlin, 1891, vol. ii.

³ Bibliotheca medica, 1896, Heft 6.

⁴ Virchow's Archiv, Band elv.

⁵ Ztsch. f. Heilkunde, Berlin, 1898, Band xix.

examination of the stomachs of luetic subjects frequently reveals syphilitic changes in the form of miliary gummas and diffuse syphilitic inflammation.

For many years all healed scars in the apices of the lungs were considered tuberculous; latterly, it has been recognized that many such scars are luetic in origin, that pulmonary syphilis is by no means so rare as it was formerly supposed to be. Similarly, more careful examinations will reveal the fact, as Aristoff has indicated, that gastric syphilis is not merely a medical curiosity. At present we may suspect specific stomach disease in all luetic subjects who have an intractable dyspepsia which does not yield to the ordinary procedures; but further than that we cannot go. There are no special symptoms which point to stomach syphilis except a definite luetic history and improvement under specific treatment—and even this last may prove deceptive, because we know that mercury and the iodides are alone sufficient to cause intractable dyspepsias, and that when they are discontinued the gastric symptoms abate. The only definite clinical symptom which may prove of value is the fact that the mucous membrane of syphilitic subjects bleeds very readily, and that the introduction of the stomach tube for diagnostic purposes is often followed by profuse hemorrhage. This is a secondary manifestation due to syphilitic hemorrhagic diathesis, and has been noted by Zeissel.⁶ If in such cases an ordinary ulcer can be excluded, we may hit upon the real cause of the stomach trouble. This bleeding occurred in one of my own cases, and led to the suspicion of syphilis. Antiluetic treatment soon caused the patient's stubborn stomach disorder to disappear, and readily confirmed my suspicions as to the nature of the disease.

Gastric lues appears in three forms: (a) As syphilitic ulcer; (b) as syphilitic tumor; and (c) as syphilitic stenosis of the pylorus. This last, the rarest of the three forms described, may cause a diffuse cellular thickening of all the layers of the pyloric end of the stomach, and can readily be mistaken for a carcinoma. It may infiltrate the smaller curvature of the stomach, or may be confined to the pyloric end; for in syphilis, as in carcinoma and tuberculosis, the smaller curvature and the distal end of the stomach are the sites of predilection. Depending on the location of the lesion, the stomach may be small or dilated. Syphilis of the stomach has been found from the twenty-third to the seventy-third year; it may be hereditary or acquired; it occurs twice as often in men as in women; and when recognized surgically or on the postmortem table it is always of the tertiary type, whereas, when discovered clinically, it is usually of the secondary type. The disease may appear from the second to the fourth year after the primary lesion, though in hereditary lues the symptoms have been known to manifest themselves after a lapse of twenty-five years.

⁶ Wien. med. Presse, 1902, xliii.

PATHOLOGY. The greatest number of cases described were of the acquired form, but they may also be of the hereditary type. Büttner⁷ reports three cases in foetal life, which, added to those already reported by Klebs, Cornil and Ranvier, Weichselbaum, Birch-Hirschfeld and Chiari, make only twelve cases in all.

In hereditary syphilis miliary gummas are found in the mucosa, submucosa, muscularis, and peritoneum. The vessels are narrowed and thickened, with here and there endarteritis obliterans. In the tissues themselves there are diffuse infiltrations, with necrosis and ulceration, but rarely complete perforation. In addition, embryonal tissue is frequently found. The acquired form of syphilitic gastritis manifests itself two to four years after the appearance of the chancre, and may appear pathologically as:

1. *Diffuse syphilitic gastritis*, with hyperemia and round-cell infiltration of all the layers of the stomach. It differs from ordinary gastritis in the greatly increased number of round cells in the submucosa and the formation of true gummas. Often, however, the pathological changes in the stomach are secondary to the morbid changes in the liver, pancreas, and small intestine. The gummas are the most characteristic growths found in gastric lues, and appear as more or less indurated plaques, or as vast zones of infiltration, going to the extent of a concomitant perigastritis. The number of these gummas is various; often they are exceedingly numerous, and they may vary in size from a few centimeters to the size of the palm of the hand. They are generally dirty white or yellow in color, rarely reddish, with hard, well-defined borders. Cross-section shows thickening of all the coats. Histologically, only the submucosa shows gummatous infiltration, while, as a result of the production of new tissue composed of embryonal cells and dense fibrous tissue, there is compression of the peptic glands and the usual luetic changes in the bloodvessels.

2. *Ulcers.* Syphilitic ulcers may exist alone or may be associated with gummas. Like simple peptic ulcers, they may be multiple, though they are usually solitary. They may be found anywhere, but the site of predilection is the posterior aspect of the cardia and the pylorus. They are usually round or oval, though occasionally irregular in form, and vary in depth from superficial erosions to complete perforation, either perforating rapidly into the free peritoneal cavity or more slowly with attendant perigastritis. Characteristic for this lesion are thickening of the mucosa and submucosa and nodules of infiltration followed by central necrosis, together with the constant finding of endarteritis and endophlebitis. The scars from healed syphilitic lesions are of doubtful value in a correct diagnosis, and are usually hard, white, and stellate.

In the earlier stages of these syphilitic lesions there is a tendency

⁷ Prag. med. Woch., 1893, xviii.

to extend into the muscularis, the mucosa being affected much later. In the last stage of the development of the disease there is the usual obliterating arterial change found in all syphilitic lesions, thickening of the serosa with adhesions to the neighboring organs, and sometimes hyaline thrombosis with organization. Very commonly the ulcer extends deeply into the muscle, this being especially characteristic of syphilitic lesions everywhere.

3. *Tumors of syphilitic origin* are found but rarely in the literature and then only in postmortem records. In Einhorn's⁸ cases, as in those that came under my own observation, all presented clinical characteristics of true carcinomas. There was progressive emaciation, together with all the other earmarks of malignant growth. Chemically, the stomach contents varied from the normal amount of free hydrochloric acid to complete absence thereof. Lactic acid was also absent, but there was present a considerable amount of sticky mucus streaked with blood. In the cases of syphilitic pyloric stenosis described by Einhorn, there was ischochymia coincident with the presence of a large, round, oval tumor at the pylorus. Two such cases came under his observation, and are probably the only ones which have been recognized clinically. Both of these cases improved under antisiphilitic treatment, though, as he rightly says, it may be seen readily that surgical intervention might have to be resorted to in order to correct the mechanical difficulty resulting from the syphilitic process.

I append the report of two cases of syphilitic tumors of the stomach which came under my personal observation:

CASE I.—An old lady of sixty years, greatly emaciated, with nothing special in her previous history except two or three miscarriages, presented herself in the clinic with distinct gastric symptoms. There was loss of appetite and occasional vomiting of sour masses; at times also particles of food that she had taken the day before. Upon examination, a hard nodular tumor was felt in the region of the pylorus, and a diagnosis of carcinoma made. The patient then disappeared from observation for at least several months, when, much to our astonishment, she reappeared, after we had long consigned her to the land beyond. On physical examination the pyloric tumor was unchanged, but it was now possible to feel over the right border of the liver a second tumor, hard, nodular, and similar in consistency to the first one described. On account of the history of her miscarriages, vigorous antiluetic treatment was instituted, and the patient rapidly improved, though when I last saw her the tumor had not materially decreased in dimensions, our experience in this respect not being similar to Einhorn's.

CASE II.—The second case was almost exactly like the first described, only the patient was a male. When I last saw him he was

⁸ Archiv f. Verdauungskrankheiten, vi, 150.

in a fairly good physical condition, the antisyphilitic treatment which was instituted having had a pronouncedly favorable effect on his symptoms.

These two cases show us the importance of giving the patient the benefit of the doubt in all so-called inoperable cases of carcinoma by giving them strict antisyphilitic treatment, which can in no case do them any harm and may be of great benefit.

SYMPTOMS. The symptoms of syphilitic gastritis are very diverse. They are commonest in the secondary stage and are due to a variety of causes. First and foremost, they may result from the general inanition and anemia attendant on syphilis, and, as in many other constitutional diseases, are not especially characteristic. We may have excretory or motor disturbances, with their attendant symptoms, such as hyperacidity, hypoacidity, and occasionally total absence of stomach secretions. Sometimes the stomach may fail to empty itself promptly, and in such cases there may even be intractable vomiting, approaching in severity gastric crises. Unlike the crises of tabes, however, these attacks readily yield to anti-luetic treatment. In another class of cases the vomiting is somewhat less severe, but more persistent, resembling in some degree the vomiting of pregnancy. There is great variation in appetite, from complete anorexia to bulimia, attended by great thirst.

In tertiary syphilis, which is usually diagnosticated only at operation or on the postmortem table, the symptoms are very obscure. There may be, but rarely, the symptoms of acute gastritis, with its attendant pain, belching, and vomiting. Commoner is the chronic form of gastritis with pain and tenderness, the pain being commonly more severe at night, irregular vomiting, anorexia, associated with diarrhœa and meteorism—symptoms refractory under ordinary treatment, but readily controlled by specific treatment.

More important is syphilitic gastric ulcer, which differs clinically in no wise from ordinary peptic ulcer except in its peculiar intractability to all ordinary medical treatment, though it is more easily controlled if to the usual procedure of diet and rest are added the anti-luetic treatment. Syphilitic ulcers may, for purposes of clinical description, be divided into three groups: (1) Those which are preceded by stomach trouble, without anything especially characteristic about them; (2) the acute variety, like the ordinary round ulcer; (3) those which first run a latent course, and then suddenly manifest themselves by an alarming hemorrhage.

The prognosis naturally depends upon an early recognition of the condition, some cases running a fulminating course.

In syphilitic ulcer of the stomach there may be pain about the ensiform, radiating through to the back, hematemesis, melena, etc. Fournier,⁹ for example, tells of a stomach hemorrhage in a woman

⁹ *Klin.-therap. Woch.*, 1900, vii.

who had acquired lues six years previously, and who recovered completely after antisyphilitic treatment was instituted. Flexner¹⁰ reports an undoubted case of perforating syphilitic stomach ulcer. Mackay¹¹ reports a syphilitic ulcer with hematemesis in a young man, suffering from hereditary lues, who was greatly benefited by the use of mercury and the iodides.

Einhorn, unlike Fraenkel, believes that stomach syphilis is not a rare condition. He reports three kinds of cases: (a) Ulcers on a luetic basis; (b) syphilitic tumor of the stomach; (c) syphilitic pyloric stenosis; and he cites a number of cases in support of his views.

Gaillard¹² also concludes that stomach syphilis is not as rare as had been previously supposed, and wonders why it is not as reasonable to attribute ulcerations lower down in the intestinal tract to the same cause (namely, syphilis) as those which attack the buccal mucous membrane and pharynx; in support of his views he cites a number of authors to support his contention, such as Andral, Hayem,¹³ and others, who have successfully cured obscure dyspepsias with mercury and the iodides. Anatomically, gastric scars in syphilis have been found by Frerichs, Chvostek, and others; and gummas by Klebs and Carril; while simple round perforating ulcers in luetic individuals have been described by Murchison and Fraupé. The last-named author comes to the following very necessary conclusions: (a) That gastric syphilis is not as rare as has been supposed; (b) that there are three anatomical lesions of a syphilitic character; (c) that the treatment bears out the suspicions of the luetic basis of many obscure stomach lesions.

L. Gaillard's views of syphilitic stomach disease are embodied in the following pathological summary: (A) Hereditary lues, in which are found miliary gummas, first in the mucosa and submucosa; later, in the muscles of the peritoneum, with obliterating endarteritis. Diffuse infiltrations, with the formation of embryonal tissues. Necrosis and softening of the syphiloma. Ulcerations are frequent, perforations exceptional. (B) Acquired syphilis, with morbid findings, such as have already been discussed.

Here I refer to a number of cases of stomach syphilis reported by Hayem, Morgan,¹⁴ Hoover, Hemmeter and Stokes,¹⁵ which are exceedingly interesting, but of which, for the sake of brevity, I must omit more detailed mention. Nor can I in the space allotted me do more than refer to gastric cirrhosis following syphilis, which has received considerable attention from French authors; nor shall I

¹⁰ AMER. JOUR. MED. SCI., 1899, n. s., vol. cxvi.

¹¹ Lancet, London, 1898, vol. ii; Syph., Paris, 1903, vol. i.

¹² Presse méd., Paris, 1897.

¹³ Ibid., 1906, vol. xiv; Rev. de Méd., Paris, 1889, vol. ix.

¹⁴ American Medicine, Philadelphia, 1906, n. s., vol. i.

¹⁵ Johns Hopkins Hospital Reports, 1900, vol. ix.

enlarge upon the interesting case reported by Lafleur,¹⁶ which was exceedingly suggestive of malignancy until microscopic examination proved it to be specific.

SYPHILIS OF THE INTESTINE. In Büttner's cases of congenital syphilis of the stomach there was, as already stated, syphilis of the small intestine. Hayem and Tissier report similarly in reference to a case of syphilis in which the patient, a woman journalist, aged thirty-three years, was admitted to the hospital. She gave a history of having what was called scrofula and hemiplegia, which, however, lasted only two months. She was now admitted to the hospital in a typhoid state, presenting on examination a papulo-squamous syphiloderm. She died on the fourth day, and at the autopsy numerous ulcers in the cecum and colon, of various dimensions, irregular and round were found. The borders were indurated, the base whitish, covered with a purulent exudate, and surrounded by a reddish areola. Microscopically, there was found infiltration of all the layers, with congestion of the vessels, which also showed an end- and peri-arteritis.

Hueter¹⁷ reports the following case of a woman, aged forty-four years, who for the past four years had enlarged inguinal glands and obstinate diarrhœa. Death resulted from intercurrent pneumonia. At the postmortem there was found, in addition to lues of the rectum and arch of the aorta, multiple ulcerations in the lower ileum, with corresponding constrictions and ampulla-like dilatations between the strictures. The distinguishing features which speak for lues of the intestine are: multiplicity of the lesions collected in groups, the tendency to ring-like formation, and plaque-like infiltration, all of which were present in this case.

Similarly, Gutman¹⁸ reports a case with autopsy findings, and gives general conclusions thereto. A woman, aged forty years, was admitted to the hospital suffering from diarrhœa and great loss of weight. She had had no abortions, and her history was negative as to alcoholic excess, lues, or tuberculosis. On the day of admission she had chills, accompanied by fever, which continued, with remissions, until seven weeks later, when she died of pneumonia. No tubercle bacilli were found in the sputum or feces. At the autopsy, after the omentum was uncovered, the small intestine from the jejunum down presented a number of annular constrictions, with dilatation of the gut between them. The peritoneum over these places was thickened, as was also the mesentery. On opening the bowel, it was found that the annular constrictions described corresponded to ulcers on the mucosa. The ulcers were flat, the edges undermined here and there, the base smooth, bluish red or yellow, and firm to the touch. No nodules were found.

¹⁶ Montreal Medical Journal, 1903, vol. xxxii.

¹⁷ Münch. med. Woch., 1906, vol. liii.

¹⁸ Deut. med. Woch., 1903, vol. xxix.

Microscopically, the floor of the ulcer was found to be formed of the submucosa, which was infiltrated with round or polygonal cells, invading the muscularis and serosa, and extending to the mesentery. No tubercles or giant cells were found, though obliterating endarteritis was present.

The case of syphilis of the intestines which came under my own observation follows: The patient, a male, aged thirty-eight years, had always been well, except for syphilis acquired fifteen years previously. During the last three years before consulting me he suffered from intractable diarrhœa, with fourteen or fifteen bowel movements daily. The stools were thin and watery, with an admixture of blood and pus. Neither the rectoscope nor sigmoidoscope showed the presence of an ulcer; however, upon deep palpation over the sigmoid, exquisite tenderness was elicited. From this fact, and on account of the previous luetic history, a tentative diagnosis of syphilitic ulcer of the bowel was made and a vigorous antisyphilitic treatment instituted, intravenous injections of 1 per cent. bichloride of mercury being given. Within a very short time the diarrhœa stopped, the stools became formed, and their number reduced to one daily, in spite of a liberal mixed diet.

From the history and results of treatment, we may add this case to those already enumerated, although we have no anatomical findings to support our diagnosis. Such cases may run with a low continued fever, reminding one somewhat of typhoid, and are often very puzzling. If, however, we take into consideration the fact that the pathological anatomists have shown that syphilis may cause retracting and radiating scars of the intestine, besides involvement of the bloodvessels in an obliterative endarteritis, there is no reason why we cannot look upon syphilitic enteritis as a clinical entity, in which the symptoms may be due either primarily to the syphilitic toxin, or secondarily to the anatomical changes of syphilis.

Fournier was the first to call attention to the existence of a febrile affection like typhoid fever due to syphilis of the intestine. He sees no reason why the luetic virus, attacking every other organ, should not as well affect the intestine. The addition of scars, retracted and radiating, involvement of the peritoneum and bloodvessels, establish the contention that syphilis of the gastro-intestinal tract is not a clinical curiosity, but a well-defined condition with characteristic lesions.

Homen¹⁹ reports a case of a man, aged twenty-three years, who for many years had gastro-intestinal trouble. He gave a direct luetic history, for which he was treated, with apparently fair recovery. Later, however, he commenced to have nocturnal abdominal pains, diarrhœa alternating with constipation, bloody stools, and abdominal distention. He died of an influenzal pneumonia. At autopsy

¹⁹ Central. f. allg. Path. u. pathol. Anat., Jena, 1893, iv.

the small intestine was found to have been constricted in thirty different places by scars, 1 cm. wide, and circularly disposed. Over the mucosa there were over thirty ulcers with smooth bases and thickened edges. The submucosa was greatly infiltrated.

CONCLUSIONS. The diagnosis of stomach syphilis can be considered probable if, with luetic history and specific scars, there are found at the same time gummatous infiltrations. The hemorrhages can most easily be explained by concomitant portal obstruction. Clinically, the fact must not be lost sight of that in luetic subjects who have been overdosed with iodides and mercury there are often profound digestive disturbances, and that these disturbances must in no wise be confused with gastric lues, for in gastric syphilis the stomach symptoms improve under specific therapy, whereas the first named are aggravated by Hg and KI.

The conclusions drawn by Reder as regards lues of the small intestine are: (1) Ulcers are found in the entire small gut, especially in the lower jejunum; (2) they always occur in groups, and the number thereof may be very great; (3) they are always annular, and the floor is deep and smooth; (4) they always produce stenosis; (5) they are all similar histologically; and (6) the lesion begins with a new cellular infiltration, surrounding the vessels especially.

TREATMENT OF SYPHILIS OF THE STOMACH. From the foregoing it will be readily seen that when there is suspicion of a syphilitic etiology for otherwise obscure stomach trouble, we must proceed with the greatest caution in instituting antisiphilitic treatment. It must not be forgotten that this disease causes profound pathological changes in the stomach itself, and that for this reason the use of the specific treatment usually employed will not be sufficient to remedy the disease. To begin with, the iodides and mercury, if their use is determined upon, must be given in such a form as not to cause further irritation to the stomach. The mercury should therefore not be given by the mouth; it is best exhibited in intravenous injections—as 1 per cent. bichloride of mercury in a dosage of 0.5 to 1 c.c., given three or four times a week. The iodides are particularly obnoxious to a sensitive stomach, and should either be given per rectum, in the proper dosage, or, if given by the mouth, should be well diluted; moreover, it has been found that the sodium salt is less irritating to the stomach than the potassium. Mercury may also be given in the form of inunctions. The inunctions should be given six days in succession, and on the day on which they are omitted it is well to advise a Turkish bath. Mercury may also be given intramuscularly, with the usual precautions, and for this purpose a 2 per cent. oxycyanide may be chosen. In addition, as before indicated, the diet should be carefully regulated, as it would be in any other corresponding stomach disease. If there are hemorrhages, the patient should be put at rest in bed with rectal feeding, and if surgical complications arise, they should be treated as any other

surgical complications would be, irrespective of the syphilis. A constricting tumor of the pylorus, for example, if followed by dilatation of the stomach and intractable vomiting, which does not yield to syphilitic medication alone, should be excised or a gastro-enterostomy should be performed, even though syphilitic subjects are, as a rule, poor surgical subjects. Yet in these cases we should not hesitate any more than we would in cases of diabetes, when the indications are to save life, even in spite of the diabetes. When once the stomach symptoms have abated, the patient should be given to understand that repeated antisyphilitic cures are necessary, in order to avoid constitutional symptoms in the future.

THE LIVER IN TUBERCULOSIS.

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THE liver in tuberculosis has been studied by a number of observers in the course of the last century. By the earlier observers it was thought to be only rarely the seat of tubercles or other manifestation of the general disease, but with the improvement of the microscope and histological methods, we find that very few cases of tuberculosis go to autopsy without some evidence of the disease in the liver.

Louis,¹ in 1843, found tuberculosis of the liver but twice in 120 autopsies on tuberculous subjects. Forster,² in 1854, was able, after a prolonged search, to find but three cases of hepatic tuberculosis. In an investigation undertaken by Bristowe,³ in 1858, to discover the relation between liver abscess and intestinal ulceration, he found that of 167 cases of tuberculous ulcers of the intestine, but 17 showed "tuberculous cavities of the liver." Waldenberg,⁴ in 1869, reported that it is the organ most frequently affected in experimental tuberculosis, but this is due to inoculation into the peritoneal cavity. Arnold,⁵ in 1880, considered it an almost constant finding in cases of tuberculosis. Simmonds,⁶ in 1888, found it in 70 per cent. in adults, in 92 per cent. in children, and in 78 per cent. in general. Zehden,⁷ in 1897, found miliary tubercles in 50 per cent. of fatal cases, corresponding with the frequency of intestinal ulceration. Rolleston⁸ is inclined to put it at a lower figure than 50 per cent. Rosenberger,⁹

¹ *Recherches sur la phthisie*, Paris, 1843.

² *Trans. Brit. Path. Soc.*, 1858, ix, 211.

³ *Virehow's Archiv*, 1880, Band, lxxxii.

⁴ *Centrbl. für path. Anat.*, 1897, viii.

⁵ *Trans. Phila. Path. Soc.*, 1906, ix.

⁶ *Handb. der spec. path. Anat.*, 1854.

⁷ *Die Tuberculose*, Berlin, 1869.

⁸ *Deut. Archiv für klin. Med.*, 1888.

⁹ *Diseases of the Liver*.

in 1906, found miliary tubercles in 83.8 per cent. of livers examined histologically, and White,¹⁰ in 1907, found them in 70.3 per cent.

Tuberculosis manifests itself in the liver as: (1) Miliary tubercles; (2) solitary tubercles; and (3) tuberculous cirrhosis.

I. MILIARY TUBERCLES. Miliary tubercles are decidedly the most common manifestation of tuberculosis in the liver, and have been described by many observers. They are usually found either in or adjoining the portal spaces, but may be found within the lobule. It is thought by most men that the infection comes from ulcers of the intestine by way of the portal vein, and that the lesion is located in the portal spaces for that reason.

Infection of the liver may take place in utero, the bacilli being transmitted by the umbilical vein. Sabourad,¹¹ in 1891, found miliary tubercles of the liver and spleen in a child eleven days old, in whose mother there was phthisis pulmonalis, but no genital or mammary tuberculosis. He concluded that the infection travelled by way of the umbilical vein. Nocard,¹² in 1895, reported a case of tuberculosis of the liver in a calf, in whose mother's placental cotyledons there were tubercles containing giant cells. Von Honl¹³ found tubercles in the liver and other organs of a fifteen-day-old child in whom the tubercles undoubtedly antedated birth. His reason for believing that they were older than fifteen days was the amount of fibrous tissue about the lesions. D'Arrigo¹⁴ inoculated female guinea-pigs with tuberculosis, and then allowed them to become pregnant. Some went to term and others aborted. In those going to term the offspring showed tubercles, particularly of the abdominal organs. In those aborting after the first half of pregnancy there were tubercles and tubercle bacilli in the livers of the offspring. Bar and Renon¹⁵ inoculated into animals the blood from the cut umbilical cord of children born of tuberculous mothers. In two cases out of five the animals showed tuberculosis. In one case the child died, and portions of its organs were inoculated into animals and produced tuberculosis in the animals. From the observations of these authors we conclude that tuberculosis can be carried from mother to child by way of the umbilical vein, and that it usually manifests itself in the liver.

In the adult the infection is generally considered to take place by way of the portal vein. Rolleston thinks that the infection takes place by way of the portal vein in chronic tuberculosis, and by way of the hepatic artery in acute tuberculosis. This view is also held by Zehden, who thinks that the initial foci are apt to be in the intermediate zone of the acini, where the lumen of the vessels is the

¹⁰ Third Annual Report, Henry Phipps Institute, 1907.

¹¹ *Semaine méd.*, 1891, No. 85.

¹² *Revue de la Tuberculose*, 1895.

¹³ *Acad. des sciences de l'Empereur Franz Joseph I, Bulletin International*, Prague, 1895.

¹⁴ *Centrbl. für Bakt.*, 1900.

¹⁵ *Soc. de biologie*, June 29, 1895.

narrowest. Orth¹⁶ thinks that the infection travels from the portal vein by way of the lymph channels. Kotlar¹⁷ made very careful examinations of the liver histologically and bacteriologically, and came to the conclusion that the infection was hematogenous and not via the bile ducts. Lancereaux¹⁸ thinks that it comes from the intestine by way of the portal vein. Klebs¹⁹ thinks with Zehden that the infection starts in the intermediate zone and spreads peripherally via the lymph channels. Gibbert and Lion²⁰ produced tuberculosis of the liver experimentally by injecting tubercle bacilli into the portal vein. The tubercles were found partially in the portal spaces and partially in the lobules.

Histological examination of 100 livers was made by us. The blocks were cut as for the routine histological work, no special care being taken to pick out pieces that seemed to contain tubercles. Of the 100 livers, miliary tubercles were found 79 times. Some of these lacked the giant cell, but the other characteristics were present, and we had no hesitancy in calling them tubercles. Seventy-four livers were stained for tubercle bacilli, with a positive result in 28, a percentage of 37.9. The infrequency with which tubercle bacilli are found in the liver has been commented upon by a number of observers, notably Baumgarten,²¹ Brissard and Loupet,²² Hanot and Lauth,²³ and Koeckel,²⁴ and we found that they are extremely hard to demonstrate. In two cases of acute miliary tuberculosis we found them in large numbers, but in all the rest we could only find a few, and then after a prolonged search.

The position of the tubercles was periportal 40 times, intracinal 17 times, and both periportal and intracinal 22 times. In a series of 45 examined particularly with reference to intestinal ulceration, the ulcers were found 38 times. Of these 38, the lesion in the liver was periportal 26 times, in 3 the lesion was intracinal, and in 9 the lesions were both periportal and intracinal. In the 7 cases showing no ulcers in the intestine, there were periportal tubercles in 2, intracinal in 3, and both periportal and intracinal in 4 cases. It seems likely from the findings in these cases that the infection generally comes from the intestine via the portal vein, but that in all probability it does come also from the general circulation by way of the hepatic artery. In two cases of acute miliary tuberculosis the tubercles were found in the portal spaces and also scattered throughout the parenchyma, and it is probable, as asserted by Zehden, that the infection in acute tuberculosis comes by way of the hepatic artery.

¹⁶ Virchow's Archiv, 1871, Band lxvi.

¹⁷ Ztsch. für Heil., 1894, iv.

¹⁸ Traité des Maladies des Foie et du Pancréas, 1899, 662.

¹⁹ Allg. Path., 1869.

²⁰ Société de biologie, 1888.

²¹ Ztschr. für klin. Med., Band ix, x.

²² Études Exp., Sous la direct. du Prof. Verneul, I, Paris, 1887.

²³ Ibid., II, Paris, 1888.

²⁴ Virchow's Archiv, 1896, Band cxliii.

II. SOLITARY TUBERCLE. Under this heading we include all the large caseous masses occurring in the liver, whether single or multiple. This is a very constant finding in the liver of many of the lower animals, particularly birds, where it is the only organ attacked in 20 per cent. According to Hutchinson,²⁵ tuberculosis of the liver was absent but twice in a series of 25 cases of avian tuberculosis. It occurs also very often in the liver of monkeys and cattle. Under this heading there are two subdivisions: (1) Conglomerate tubercles, and (2) tuberculous cavities or bile duct tubercles.

By *conglomerate tubercles* is meant the collection of large caseous masses which are found scattered throughout the liver substance. Craven Moore²⁶ reports a case of conglomerate tubercles in the liver in a case of cancer of the stomach, and thinks that the infection came from the ulcerated surface in the stomach. Orth reported two cases, but it was before the discovery of the tubercle bacillus, and the diagnosis was disputed by Zehden and Simmonds,²⁷ who think he had to do with either a gumma or a cancer. Other cases are reported by Simmonds, Rolleston, MacKenzie,²⁸ Anderson,²⁹ Middleton,³⁰ and Clement.³¹ The centres of the nodules may undergo softening, in which event we may have the appearance of a cavity with caseating walls.

The *bile duct tubercles* are so called because of their association with the bile ducts, and it was claimed by Virchow that the ducts were occluded by tubercles and cysts formed. It has also been thought that the infection came from the intestine by way of the bile duct. Both these theories seem to be in error. Instead of the bile duct being occluded, it is likely that the tubercle caseates and breaks down, leaving a caseating cavity, which communicates with a bile-duct by extension and is oftentimes blood- or bile-stained, and this has given rise to the idea that the bile duct is occluded and forms a cyst.

As to the source of the infection, it has been claimed by Simmonds that it came by the bile duct, but Sargent,³² Kotlar, and Sabourin³³ think that it comes by the portal vein or the hepatic artery, and that the duct is only secondarily involved by extension, the tubercle breaking into the duct and infecting it, and in this way producing other tubercles. Cases are reported by Simmonds, Hare,³⁴ Wethered,³⁵ and MacKenzie. In our series we have one case showing solitary

²⁵ Studies in Human and Comparative Pathology, p. 304.

²⁶ Medical Chronicle, October, 1889.

²⁷ Centralblatt für allgemeine Path., November, 1898.

²⁸ Transactions Path. Soc., xli, 146.

²⁹ The Australian Medical Gazette, March 20, 1899.

³⁰ Glasgow Journal, February, 1893.

³¹ Virchow's Archiv, vol. cxxxix.

³² Thèse de Paris, 1895.

³³ Le foie des tuberculeux, Archiv. de physiol. norm. et path. le 1^{er} Juillet, 1883.

³⁴ Transactions London Path. Soc., 1858.

³⁵ Ibid., 1889.

tubercles associated with miliary tubercles. The lesions averaged about 1.5 cm. in diameter, there was a number present, but there was no cavity formation.

CIRRHOSIS. Cirrhosis of the liver may accompany tuberculosis and be due to an entirely different cause. For instance, we may have an alcoholic cirrhosis, superimposed upon a tuberculous infection. We may also have cirrhosis of the liver with tuberculosis elsewhere in the body, but it has long been felt that there is a fibrous hepatitis due to the tubercle bacillus. Brieger, in 1879, described a fibrous hepatitis occurring in tuberculous patients, with the formation of fibrous tissue which enclosed the lobules, together with the newly formed bile ducts. Rolleston discusses at some length cirrhosis of the liver associated with tuberculosis. He quotes Hanot and Gilbert, who describe a large fatty liver with a small-cell infiltration and fibrous hyperplasia of the portal spaces, together with miliary tubercles. This they call "hypertrophic fatty tuberculous hepatitis."

These authors describe two other forms: (a) Cirrhosis without any enlargement of the liver; (b) cirrhosis with more fibrous tissue than the variety just mentioned, but with similar fatty change and tuberculous infiltration. The two latter forms differ only in the fact that one shows marked nodules, like those seen in cirrhosis with adenomas. Rolleston thinks that these forms occur, but he does not think them tuberculous. He considers it reasonable to suppose that the tubercle bacillus is capable of a sclerogenic effect on the liver. In animals, as in guinea-pigs, Hanot and Gilbert were able to produce a cirrhosis of the liver by the injection of avian tubercle bacilli, while human tubercle bacilli produced fatty change or fatty coagulation necrosis. Hanot found a deeply scarred liver, like that of acquired syphilis, associated with miliary tubercles in the organ. Collet and Gallivardin, according to Rolleston, report a case of tuberculosis of the portal spaces with a delicate fibrosis accompanying. Mixed infection, according to Rolleston, may set up a gastritis and a consequent dyspeptic type of cirrhosis. A marked grade of passive congestion may set up a cirrhosis—the so-called cardiac cirrhosis.

In this series one case of atrophic cirrhosis was found, and newly formed bile ducts and a slight increase of fibrous tissue several times; but the data are insufficient to warrant a conclusion that the tubercle bacillus is an etiological factor in these changes.

COINCIDENT PATHOLOGICAL PROCESSES. *Amyloid Degeneration.* This is a more or less frequent occurrence in chronic tuberculosis, not only of the lungs, but also of the bones. In this series it was found ten times, or 10 per cent.

Fatty change in the liver has been the subject of much discussion. Langerhans thinks that it is due to paralysis of the hepatic cells, and that the fat physiologically stored there is not given up. Klebs

thinks that it is the direct result of the tuberculous process on the lymphatic apparatus of the liver, the lymph outflow being hindered and the fat retained. In our series it was present in 35 cases, or 35 per cent.

Congestion. The occurrence of congestion in the liver is, of course, not characteristic of this disease, and yet it is an almost constant finding. In chronic lung disease the embarrassed respiratory apparatus, with its effect upon the right heart, sooner or later gives rise to passive congestion. The liver, with its close proximity and its blood supply, is one of the first organs to show the change. In our cases we classified the congestion as slight, moderate, and severe. There were 25 cases of slight congestion, 47 of moderate, and 22 of severe. In 6 cases congestion was not present.

CONCLUSIONS. 1. Miliary tubercles are found in the great majority of the livers of the cases of chronic phthisis autopsied.

2. Solitary tubercle of the liver is a very rare manifestation.

3. The infection probably is hematogenous, the bacilli being carried to the liver by the portal vein and the hepatic artery. In most cases the infection arises in intestinal ulcers.

4. Passive congestion of the liver is found in nearly every case of pulmonary tuberculosis, while amyloid and fatty change are found in a relatively small number of cases.

5. From our cases we are not convinced that a fibrosis or cirrhosis of the liver due to the tubercle bacilli does occur, and are more inclined to think that the fibroses found are due to other etiological factors.

My thanks are due to Dr. C. Y. White for the material on which this report is based.

ASCITES IN CIRRHOSIS OF THE LIVER CURED BY REPEATED TAPPINGS.

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In a paper widely read and frequently quoted, Hale White¹ has expressed himself in very pessimistic terms concerning ascites in cirrhosis. In studying the records of Guy's Hospital for five years, the works of Frerichs² and Murchison,³ and a paper of Dr. F. Taylor,⁴ he was unable to find a single patient with ascites due

¹ Guy's Hospital Reports, 1893, xlix, 1.

² A Clinical Treatise on Diseases of the Liver. The Sydenham Society, London, 1861.

³ Diseases of the Liver, 1867.

⁴ Guy's Hospital Reports, xxxvi.

to uncomplicated cirrhosis who had lived long enough for a second paracentesis. He insists that a patient with alcoholic cirrhosis and ascites has not long to live. At the opening of his paper he says: "Another point which I shall try to prove is, that if a patient, who during life is supposed to be suffering from cirrhosis of the liver with ascites, has the abdomen tapped, but life is sufficiently prolonged to allow a second paracentesis to be necessary, the diagnosis of cirrhosis of the liver is almost certainly completely wrong, or, at any rate, the patient has something else the matter in addition to his cirrhosis, and further, it is highly probable that he has some form of chronic peritonitis, of which what is ordinarily called perihepatitis is merely a variety." Although written fifteen years ago, and although Hale White's principal objection to the cure of ascites in cirrhosis has been removed by autopsy experience, his paper in its main contention that many alleged cirrhotics are suffering from some entirely different disease holds perfectly good today. In mentioning some recorded cases of cured ascites in cirrhosis, Quincke and Hoppe-Seyler⁵ remark: "When in uncomplicated cirrhosis ascites once develops, it disappears only exceptionally." Hilton Fagge⁶ stated his belief that death in cirrhosis occurs from six weeks to six months after the detection of ascites, although he admitted the possibility of cure.

In view of the acknowledged rarity of the event under consideration, the following case report is perhaps not inappropriate:

History 5762, new series. Male, aged fifty-eight years, Italian, married, car cleaner; admitted to the Vanderbilt Clinic, October 9, 1907.

His mother and father died of old age. He does not remember having had the diseases of childhood nor any other acute disease; denies all venereal infection. Up to five months previous to admission he drank very heavily, and was in the habit of taking ten to twenty "whiskies" daily, often some before breakfast. He was also in the habit of consuming much beer and wine. His misuse of alcohol existed over many years. Six months previous to admission the patient noticed that his feet and shins began to swell, and two months later that his abdomen was becoming larger. Within a month the belly became so large that paracentesis was performed, and five and one-quarter gallons of amber-colored fluid was withdrawn. A month later a second aspiration was made, and four and one-half gallons was removed. A third tapping was made two weeks previous to admission, and the patient says an indefinite amount of fluid was obtained, and some blood came away in addition. Since the last aspiration the abdomen has become rapidly larger, and causes much discomfort; he is obliged to get up two or three

⁵ *Krankheiten der Leber*, Nothnagel, Spec. Path. und Therap., 1899, p. 381.

⁶ *Guy's Hospital Reports*, 1875, Third Series, xx, 155.

times at night to urinate. He has had some gastric discomfort, but no vomiting nor hematemesis. He has had no tarry stools. He has become much thinner about the face and limbs, has lost much strength, and feels very weak and ill. He has had no fever, no cough. His appetite is fair and his bowels are regular.

Examination showed the patient to be poorly nourished. The heart was slightly enlarged to the left; but otherwise negative. The pulse was 108, regular, and rather weak; there was moderate thickening of the radials. The lungs were negative. The abdomen was large and pendulous; the superficial veins were visible. There was movable dulness and a fluid wave. The liver and spleen could not be made out on account of fluid in the belly. There was moderate oedema of the shins. The urine contained a moderately heavy trace of albumin.

On October 14 the abdomen was aspirated at the patient's home, twenty-one quarts of clear serum being obtained. On October 21 the patient was admitted to the Roosevelt Hospital at his own request. He was aspirated once in the hospital. On November 19 the abdomen was aspirated, and twenty-five quarts was obtained. On December 3 twenty quarts were obtained, and on January 4 twelve quarts; the oedema of the abdomen, etc., had gone. On January 28 the circumference of the abdomen was forty-four inches. The urine was smoky and had a red sediment, contained a marked trace of albumin, but no sugar; a few hyaline casts, much blood, urobilinogen were present. On March 6 the patient said he felt well; the circumference of the abdomen was forty-one and one-half inches. The liver-edge could be felt four and one-half inches below the free margin of the ribs in the nipple line (it was never felt before). The spleen was felt for the first time, one and one-half inches below the left free costal margin. On May 21 the circumference of the abdomen was forty-one inches. The patient felt perfectly well and returned to work. On October 30 the patient had grown fat, was very active, and felt entirely well. He had returned to his excessive alcoholism. Spider angioma and dilated venules of the face had appeared. The liver and spleen were palpable. There were no signs of fluid. The circumference of the abdomen was forty-one and one-quarter inches.

Syphilis of the liver was suggested, and the possibility of the cure being due to antisyphilitic treatment was discussed. As the patient gave no history and showed no traces of that disease, as the liver when finally palpable presented none of the physical features so characteristic of syphilis of that organ, and as the antisyphilitic treatment amounted to only a few drams of potassium iodide over the entire period of observation, it seemed that hepatic syphilis did not merit serious consideration.

The question arose whether cardiac insufficiency was operative in producing the ascites. The history states that the first objective

deviation from normal health was swelling of the legs, a manifestation not ordinarily referable to portal obstruction. Frerichs has stated that too much importance must not be placed in the appearance of ascites before œdema of the feet, for, as he points out, in some cases of cirrhosis ascites and œdema of the lower extremities come on together. It is possible that in the case here reported the accumulation of fluid in the abdomen escaped the patient's notice for some time. While under observation the most rapid accumulation of ascitic fluid seemed to be coincident with the greatest degree of œdema of the legs and scrotum, and it is a fact of some significance that he was given the infusion of digitalis for a long time. Consequently, it seemed probable that the ascites was due in this case to an intrahepatic portal obstruction in an individual whose systemic circulation was not altogether adequate.

The patient died March 17, 1909, after having had the symptoms of intestinal obstruction for one week, probably due to a strangulated umbilical hernia. Permission was granted to make a small incision in the abdominal wall. About a quart of fluid was found in the peritoneal cavity, probably incident to the condition from which he died. The transverse mesocolon was adherent to the abdominal wall from the ensiform cartilage to the ninth right cartilage, and to the liver below and to the right of that point. The adhesions were not dense, nor highly vascularized. The liver was adherent to the diaphragm by a very few readily broken adhesions, was greatly diminished in size, and showed the lesions of advanced cirrhosis. There was no perihepatitis. The peritoneum, as far as could be seen, showed no evidence of acute or chronic inflammation.

A review of the literature furnishes a few examples of ascites in cirrhosis cured by tapping. MacDonald⁷ has had two cases of ascites in cirrhosis cured by tapping. An intemperate butcher, aged forty-eight years, who was aspirated twenty-one times over a period of nine months, was back at work, without ascites and feeling perfectly well, eight months after the last paracentesis. Another patient, admitted to the Montreal General Hospital in August, 1885, after sixty tapings, was cured of ascites, and four years after the last operation had had no return. Cheadle⁸ gives the history of a very alcoholic woman who was tapped twice. Fluid did not return, the patient gained weight and left the hospital. Nine months later she had to be aspirated a third time. She went through a pleuropneumonia, and although in an apparently hopeless condition recovered. Two months later she succumbed to an acute bronchitis. The postmortem "disclosed a contracted, typically hobnailed, cirrhotic liver, weighing thirty-eight ounces, with thickened capsule, but no general perihepatitis or peritonitis, and no thickening of or

⁷ Med. News, 1889, lv, 398.

⁸ Lancet, 1900, i, 987.

adhesion to neighboring structures." Cheadle also details the case of a cabman, aged forty-three years, of very intemperate habits, who was tapped nineteen times between April and August, 1894, the last aspiration being August 19. In August, 1895, he was re-admitted for hematemesis, from which he died. The liver was contracted, markedly hobnailed, weighed forty-eight ounces, and was covered by a "thick false membrane." There was no general peritonitis. H. P. Hawkins⁹ mentions an alcoholic who came under Murchison's care for cirrhosis and ascites. He became a total abstainer, lived twelve years without ascites, and died of granular kidneys and peritonitis. Autopsy showed a hobnail liver. In Casati's¹⁰ case, a cirrhotic with parenchymatous nephritis and diabetes mellitus recovered after one hundred and eleven aspirations.

In a series of 56 hospital cases, over a period of twenty years, Saundby¹¹ has contributed 3 cases in which the ascites incident to cirrhosis disappeared after a number of tapplings. Case III was tapped four times in five years and then had no return. Case LV was tapped twice, lived comfortably for three years, and then died by accident. Case LXVIII was tapped five times between June and October, 1901, and had no return of ascites up to the time of writing in 1905. Grasty's¹² case required twenty-one tapplings in thirteen months, and at the time of reporting had been free from ascites for two years. Courmont¹³ has contributed one case of ascites, cured by a salt-free diet. Bristowe¹⁴ has recorded 3 cases of ascites in cirrhosis which have been cured. Hale White, while admitting that these cases present very strong evidence of the curability of the condition, objected that there had been no autopsies to prove it. The objection, however, has since been weakened by the cases of Cheadle and Hawkins.

The disappearance of ascites is generally supposed to result from the development of a collateral anastomosis between the portal vein and the venæ cavæ, by paths too well known to warrant description at present. Admitting that such a communication is essential to the cure of peritoneal dropsy, it seems that other elements are involved in the process.

A consideration of certain observations, fairly common in the experience of medical men, may aid to an approximately accurate understanding of the disappearance of ascites in some cases of portal cirrhosis:

1. Ascites is sometimes observed when the only demonstrable lesion in the liver is chronic passive congestion resulting from

⁹ Allbutt's System of Medicine, 1905, iv, Part 1, 180.

¹⁰ Il raccoglitore medico, 1893, Fifth Series, xvi, 161.

¹¹ Practitioner, London, 1905, lxxiv, 758.

¹² The George Washington Bulletin, 1906, v, 45.

¹³ Bull. de la soc. m^{éd}. des hôp. de Lyon, 1904, iii, 48.

¹⁴ Brit. Med. Jour., 1892, i, 847.

cardiac insufficiency with or without valvular disease. Hart¹⁵ has examined 35 cases of "high grade, central, red atrophy," occurring in adhesive pericarditis, valvular and muscular disease of the heart. Normal livers were used as controls. The microscope showed dilatation of the central veins and capillaries. The liver cells were normal or diminished in size toward the periphery of the lobule, but toward the central vein the diminution became more marked, the cells appearing atrophied. The protoplasm in this situation limited itself to a small rim, until in the centre of the lobule only nuclei and their fragments were to be found. In the capillaries coagula were found which proved to be fibrin, and Hart concluded they were formed antemortem. Hale White has drawn attention to the rapid accumulation of fluid in some cases, and considers it difficult of explanation if compression of the portal radicals by slowly forming connective tissue is to be regarded as the sole cause of ascites. He suggests that rapidly accumulating ascites "is due to thrombosis of some of the minute branches of the portal vein within the liver."

2. After more or less prolonged alcoholic excess, cases of œdema of the lower extremities are occasionally seen, without abnormal signs in the heart and without albuminuria. Rest and removal of alcohol suffice to cure the œdema.

3. In a certain number of alcoholics, the liver is found to be distinctly enlarged. After alcohol has been withdrawn for a number of weeks, the edge of the liver is not as far below the costal margin as previously, and, indeed, in some cases is no longer felt. Quincke and Hoppe-Seyler speak of an enlargement of the liver in persons who subsequently become cirrhotic, probably due less to connective tissue than "to fat infiltration and congestion."

4. In some cases of cirrhosis, the disappearance of ascites seems to be coincident with the cessation of alcoholism. This was a notable feature in the case of Hawkins.

In view of these clinical and pathological facts, apparently indicating the ability of alcohol to depress the circulation and directly or indirectly to induce hepatic hyperemia, and in view of the fact that in the case here reported œdema existed which cannot be altogether explained by portal obstruction, an improvement of systemic circulation—in this case at least—seems a likely factor in the cure of ascites in cirrhosis.

¹⁵ *Beit. zur path. Anat. u. z. allg. Path.*, 1901, xxxv, 303.

ADIPOSIS DOLOROSA.

A CLINICAL AND PATHOLOGICAL STUDY, WITH THE REPORT OF
TWO CASES WITH NECROPSY.

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THE number of cases of adiposis dolorosa that have been recorded with postmortem findings is so few that the following should be of interest:

CASE I.—M. F., a housewife, white, aged fifty-seven years, a native of Philadelphia, was admitted to the alcoholic ward of the Philadelphia General Hospital, November 11, 1907, under the care of Dr. Mills; subsequently she was transferred to the service of Dr. Dercum. When admitted she was in a semistuporous condition, with a temperature of 97°; pulse, 110; respirations, 30. Her father and one brother died of consumption, her mother died of "general debility," and one brother became insane. She had the diseases of childhood, rheumatism in her wrists and knees upon several occasions, and "typhoid pneumonia" in 1876. She married when thirty-six years of age, but never became pregnant. Previous to her present illness she used alcohol in moderation, but since then has been taking a couple of "drinks" daily, to relieve her pain. She never was addicted to the use of any drug. For the past ten or twelve years she had been complaining of pain in her stomach at times, and since March, 1907, of severe pain and vomiting. On several occasions she vomited blood and passed blood from the bowels. For some time she has been very tender in the extremities, and for the past few weeks has been confused or delirious.

On examination she was a very corpulent elderly woman, with gray hair and no paralyses. The movements of the eyes could not be tested on account of the patient's condition, but they appeared normal, the pupils being equal, semicontracted, and reacting to light. The tongue was heavily coated, and without tremor. The pulse was rapid, irregular, intermittent, of small volume and low tension. The chest was well formed, the excursion good; the breasts were pendulous. The abdomen was markedly adipose; the skin of the abdomen and chest was smooth and elastic, while that over the legs was rough and dry. Marked tenderness was present all over the body, which did not seem to be limited to the course of the large nerves. Picking up some of the skin caused an outcry of pain, and touching any part of the body (except the face) caused an outcry of pain also. The outlines of the heart were increased downward and to the left and the right; no thrills were detected.

There was a systolic murmur at the aortic area, transmitted into the neck, with accentuation of the second pulmonic and aortic sounds. The breath sounds and pulmonary resonance were normal. The liver dulness extended from the fifth to the eighth interspaces in the mid-clavicular line; the spleen was not palpable but was slightly enlarged to percussion. There were two large bed sores, one on each buttock; another on the outer side of the left thigh. The biceps, triceps, knee, and Achilles reflexes were all absent. The styloid processes of the ulnæ were unusually prominent, a distinct sense of grating being felt in each wrist-joint, more especially in the right.

On November 13, 1907, a bulla about one and one-half inches long and one-half inch wide was present on the internal aspect of the left leg at the junction of the lower and middle third.

On November 14 two more bullæ were present, circular in shape, and about one inch in diameter, one being over the left knee and the other on the inner surface of the leg below the right knee. The urine was alkaline in reaction; had a specific gravity of 1020; contained no albumin and no casts, but did contain many triple phosphate crystals, many epithelial cells, and numerous leukocytes.

On November 17 three more bullæ were observed, a large one on the right heel and a small one at the junction of the metacarpophalangeal joint of each great toe.

On November 18 both albumin and casts were present in the urine.

The stupor gradually deepened, the heart weakened, the lungs became œdematous, and death occurred on November 21, 1907.

Autopsy. The findings were as follows: Fatty infiltration and degeneration of the heart; bilateral emphysema, with atelectasis of the lower lobe of the right lung; chronic diffuse nephritis; slight fatty infiltration of the liver. The subcutaneous fat in the region of the umbilicus was 6.5 cm. in thickness.

Specimens removed for examination were the brain and spinal cord, hypophysis, thyroid gland, adrenal glands, ovaries, and a portion of the subcutaneous fat containing small vessels and nerves.

Sections from the brain and cord were examined microscopically by the usual methods, but did not show any particular changes. The thyroid gland was normal in size, but presented a marked difference between the lobes—the right lobe being distinctly harder than the left. Microscopically the right lobe showed a marked increase of the connective tissue at the expense of the parenchyma. Many of the acini were very small, the rest being about normal. In the left lobe, the acini were increased in size, many being enormously enlarged. Papillomatous ingrowths or plications, such as were found in a case reported by Dereuin, were not observed. In both lobes, but especially in the right, were many areas of round-cell infiltration, not infrequently filling several adjacent acini. A

few small hemorrhagic areas were also observed. The hypophysis was normal macroscopically, but under the microscope, sections stained with hematoxylin and eosin, and hematoxylin and Van Gieson's stain showed areas of round-cell infiltration in the glandular portion. Many cells were degenerated and without nuclei. In the nervous tissue of the posterior lobe were found glandular cells of the same character as those of the anterior lobe, irregularly arranged without any enveloping connective tissue, and being completely surrounded by the neuroglia. This singular condition has been described by Berekley, who claims to have found it in normal hypophyses. I have not seen this arrangement, however, in the sections obtained from any normal pituitaries that I have been able to examine. The adrenal glands presented no abnormalities, except certain irregularities in staining. The ovaries presented marked sclerosis. The fat showed the normal histological appearance, but the nerve filaments presented both interstitial and parenchymatous inflammatory changes.

CASE II.—M. W., a female, white, aged forty-eight years, a nurse, was admitted to the medical wards of the Philadelphia General Hospital, September 30, 1903, under the care of Dr. Salinger. On admission she complained of pain in the right foot so severe that she was disabled and could not stand; the right foot was swollen. There was severe pain in the occipital region extending over to the forehead. There was photophobia in both eyes and lachrymation, especially in the right. On the second day of admission she had a severe attack of herpes labialis.

Her maternal grandfather died at the age of eighty-six years, of old age. He was a small sized man. The grandmother died at eighty-four, following a dislocation of the hip. She was a fairly tall woman and very fat, the fat being equally distributed. The patient had five uncles on her mother's side, all of whom were tall and very stout, and three maternal aunts, one of whom was a very stout woman, dying at the age of forty-seven. During the last ten years of her life the latter complained greatly of pains in her legs, which were relieved by massage. Another aunt died at fifty years of cancer of the breast; she was tall and slender. The third aunt is living, is an undersized woman, not stout, and about sixty years of age. The mother of the patient was five feet, four inches tall, very thin and always complained of rheumatism and neuralgia, and died at forty-two from paralysis. The patient states that all of her cousins on her mother's side are large and stout people, but knows little more of them than this. Her father, who is the only known member on the paternal side, was a healthy man up to five years before his death; he died at seventy-six. His right leg was larger than the left, and was very painful. The patient's mother married at twenty-three, had six children, and one miscarriage. Two of the patient's brothers died of accidents. Another died

from typhopneumonia at twenty-two, and a sister died of scarlet fever. The remaining brother is living, is very large, and suffers from rheumatism.

The patient has always been large. She had scarlet fever and chickenpox in childhood. She began to menstruate at fourteen; has always been regular. She had grippe in 1888, and made a slow recovery. She has had three children, and no miscarriages. She states that she had a goitre some twenty-two years ago. She denies venereal disease. She drinks beer, but not to excess.

On October 17, 1903, it was noticed that the patient had a swelling of the right foot that was very painful; it was relieved by massage and bandaging.

On November 3 the right foot again became much swollen and very painful, and at the same time swelling of the thyroid gland, difficulty of deglutition, and pain at the back of the neck were noticed. Subsequently the patient improved, and on December 15, being in good condition and comfortable, she was discharged.

She was readmitted on March 7, 1905, under the care of Dr. Hughes. At this time the diagnosis of myocarditis and nephritis was made, together with adiposis dolorosa. She was seen several times by Dr. Dercum, who confirmed the diagnosis of adiposis dolorosa. She was an extremely large woman, weighing 308 pounds. The superficial fat on the legs was sensitive to palpation. Her general condition was very bad, the pulse rapid, weak, irregular, and of high tension. The respirations were shallow; the expansion was poor. The superficial veins were enlarged. The abdomen was soft and not tender on palpation. The breath sounds were roughened, the expiration prolonged, and a few sonorous rales were audible. The pulmonic second sound of the heart was accentuated. There was a presystolic murmur at the pulmonic area, and the heart's action was irregular. Subsequently the patient suffered markedly from attacks of dyspnœa. Not infrequently she became markedly cyanotic. Gradually she became weaker, and died April 5, 1905.

Autopsy. The autopsy revealed, among other features, marked cardiac hypertrophy with fatty degeneration and chronic nephritis, chronic adhesive pleurisy, œdema and hypostatic congestion of the lungs, and fatty infiltration and congestion of the liver.

The thyroid gland, pituitary body, portions of the fat and skin, and a portion of a radial nerve were removed for examination. The thyroid gland was decidedly larger than normal, particularly the right lobe; the middle lobe was distinctly indurated; the lateral lobes appeared to be normal in consistence. Sections of the right lobe revealed considerable enlargement and dilatation of many of the acini. They were for the most part filled with colloid material. The cubical epithelial lining appeared to be normal, though here and there a tendency to plication of the surface was noted, and in

some of the larger acini, small intrusions and plications into the interior of the acini. In certain portions of the sections decided increase of connective tissue was noted. In these areas the acini were relatively small. No changes were noted in the walls of the vessels. Sections of the left lobe revealed an enormous number of greatly dilated acini. Plications of the cubical epithelium were also noted, occurring somewhat more frequently in this lobe than in the right. Sections of the middle lobe revealed changes similar to those already noted, except that there was a relatively larger increase of connective tissue and a smaller number relatively of large acini. In shape and size the pituitary body appeared to be normal. The capsule seemed normal. This appeared also to be the case with the blood-vessels. The glandular portion presented a couple of small areas of round-cell infiltration, but was otherwise normal. In the nervous portion the same peculiar invasion of the glandular cells was found as in Case I. The fatty tissue revealed no striking changes except here and there some apparent increase in the connective tissue trabeculae. Separate lipomas were not found. Sections of the radial nerve showed no distinct changes. However, here and there some thickening of the endoneurium existed. The perineurium appeared to be normal. Distinct inflammatory changes were not present.

The recognition of adiposis dolorosa as a clinical entity may be said to date from a paper published by Dercum¹ in 1892, under the following title: "Three Cases of a Hitherto Unclassified Affection, Resembling in its Grosser Aspects Obesity, but Associated with Special Nervous Symptoms—Adiposis Dolorosa." This was prefaced by the report of a single case by the same observer in 1888, as "A Subcutaneous Connective Tissue Dystrophy of the Arms and Back, Associated with Symptoms Resembling Myxoedema,"² and another by Henry in 1891.³ Since the appearance of these papers, about fifty cases of Dercum's disease have been reported many in detail and quite a number briefly and incompletely. In at least two of the reported cases (Fuchs⁴ and Cheevers⁵), the diagnosis is questionable, as the patients had neither spontaneous pain nor pain upon manipulation of the adipose deposits.

ETIOLOGY. It has been claimed that adiposis dolorosa may occur in families, but of the two instances reported in support of this statement (Hammond⁶ and Cheevers) that of Cheevers may, I think, be ruled out. A family tendency toward obesity, however, is not infrequent. A neuropathic heredity, or a previous personal neuropathic history, has been sometimes noted, but not with suffi-

¹ AMER. JOUR. MED. SCI., 1892, civ, 521.

² Univ. Med. Mag., December, 1888.

³ Jour. Nerv. and Ment. Dis., March, 1891.

⁴ Wien. klin. Woch., 1905, xviii, 706.

⁵ Brit. Med. Jour., 1904, vol. i.

⁶ Ibid., vol. ii.

cient frequency to make it of any special etiological significance. The disease may occur in either sex, females being affected more frequently than males, in the proportion of six to one. The majority of the cases occur between the ages of thirty-five and fifty years, although cases have been reported as commencing at twelve, seventeen, and nineteen years, and one as late as seventy-eight years. Middle aged women who have passed the menopause form the bulk of the cases.

Alcoholism and syphilis have not infrequently formed a background in adiposis dolorosa, and I differ from those who disregard them as possible etiological factors. The toxic and destructive effects of alcohol and syphilis are well known, and the fact that they frequently cause degenerative changes in the ductless glands was emphasized by Lorand.⁷

It is of interest in this connection to recall the case reported by E. W. Taylor, in which the patient developed adiposis dolorosa while convalescing from acute alcoholic neuritis.

SYMPTOMS. Adiposis dolorosa develops gradually in the majority of cases; a few have a more rapid onset; none has developed abruptly. The cardinal symptoms are: (1) Fatty deposit, (2) pain, (3) general asthenia, and (4) psychic phenomena.

Vitaut⁸ has divided the cases of adiposis dolorosa into three groups, depending upon the arrangement of the adipose deposit—nodular, circumscribed diffuse, and generalized diffuse. Of the three, the circumscribed diffuse forms the bulk of the cases, generalized diffuse coming next in frequency. Mixed types, or combinations of these forms, are sometimes seen. While the majority of the subjects are extremely obese, many weighing over two hundred pounds and one reported as weighing three hundred pounds, it should be remembered that in some instances the weight is very little, if any, above the average. This I have seen in two cases of the nodular form. The deposits of fat are found most commonly over the trunk, shoulders, arms, and thighs; the forearms and legs being less frequently affected, and the hands and face but rarely.

Pain and tenderness upon manipulation of the adipose deposits are constant symptoms; this is not true, however, of spontaneous pain, which, while the rule, may be entirely absent. Pain upon pressure over the larger nerve trunks is rare, but has been observed in two reported cases. Diminished sensation is, in my experience, a more common symptom than complete anesthesia, while paresthesias are more frequent than either, being present in some form in almost every case. These paresthesias are sensations of numbness, coldness, burning, tingling, or crawling, variously distributed, and often causing the patients much distress.

⁷ An address at a meeting of the Philadelphia County Medical Society, April 12, 1907

⁸ *Maladie de Dercum*, Lyons, 1901.

The asthenia varies in degree from a tendency to fatigue readily, to extreme weakness or prostration. It is distinctly more pronounced than the fatigue of the average neurasthenic, and is a very constant symptom.

The psychic changes that have been observed in adiposis dolorosa have a wide range, with irritability at one extreme and dementia at the other. When we consider the toxic nature of the disease, it is not surprising that confusion and stupor have each been observed. Mental depression, mental hebetude, melancholia, impairment and loss of memory, have also been noted; one patient was an imbecile, three had "epileptic seizures," two had "convulsions," one became "delusional." The most common mental syndrome is that of irritability associated with depression, some failure of memory, and a marked hypochondriacal tendency.

The tendon reflexes may be normal or increased, but are usually diminished or abolished. One case with loss of the skin reflexes has been recorded by Delecq.

Vasomotor phenomena are next in importance to the so-called cardinal symptoms. Under this heading belong the anidrosis, irregular flushings, cyanosis of the extremities, transitory œdema, and the spontaneous hemorrhages from the nose, stomach, and uterus.

Among trophic changes observed in adiposis dolorosa are ulcerations, the formation of blebs and bullæ, arthritic and bony changes. Other symptoms occasionally found are headache, dyspnœa, tachycardia, insomnia, jaundice, and tremor. Blindness was reported in two cases, circinate retinitis in one case, and hyperemia of the disk in one. Deafness was observed in two cases. The blood changes and urinary findings have both been insignificant.

Organic changes in the central nervous system may be looked upon as coincident rather than being actual symptoms. Hemiplegia and aphasia were present in one case, degeneration of the posterior column of the cord in one case, and signs of lateral tract involvement were marked in an unreported case shown by Dr. Dercum in one of his clinics during the last year at the Jefferson Hospital.

A peculiar tendency of the flesh in this disease is that of bruising upon what would ordinarily be an inadequate cause.

PATHOLOGY. Of the six autopsies reported to date, together with the two herein recorded, the findings may be briefly stated as follows:

CASES I and II.—Dercum: Macroscopic disease of the thyroid, the glands being enlarged and the seat of calcareous infiltration.

CASE III.—Dercum:⁹ Irregular atrophy of the thyroid, extensive interstitial neuritis of peripheral nerves in fatty deposits, degeneration in the columns of Goll.

⁹ Jour. Nerv. and Ment. Dis., August, 1900.

CASE IV.—Burr:¹⁰ Glioma of the pituitary body; colloid degeneration with atrophy and absence of secreting cells in many acini of the thyroid gland; interstitial neuritis of terminal filaments; sclerotic ovaries.

CASE V.—Dercum and McCarthy:¹¹ Adeno-carcinoma of pituitary body, thyroid normal, right suprarenal gland hypertrophied, hemolymph glands, interstitial neuritis, undeveloped testicles.

CASE VI.—Guillain and Alquier:¹² Hypophysis doubled in size with marked increase of connective tissue in the glandular portion and changes suggesting an alveolar carcinoma. Thyroid hypertrophied, with increase in connective tissue stroma.

CASE VII.—Price: Inflammatory changes in thyroid, with marked increase in the interstitial connective tissue, one whole lobe being especially infiltrated, the other showing compensatory hypertrophy. Inflammatory changes in hypophysis, with presence of a condition suggesting alveolar or glandular carcinoma, interstitial and parenchymatous neuritis, sclerotic ovaries.

CASE VIII.—Price: Marked increase in the connective tissue of the thyroid gland, dilation of the acini, with infoldings of the cuboidal epithelial lining. The same changes in the hypophysis as were found in Cases VI and VII, but less marked. No abnormalities of the adipose tissue.

Deleq¹³ mentions, as causes of adiposis dolorosa, disease of thyroid, testicle, ovary, and pituitary. Raymond¹⁴ says that the cause is not known and the pathology vague. Von Schroeter looks upon the condition as a "dysthyroidismus." Pineles considers that numerous blood glands are at fault, one of the causes being a hypothyroidismus. Frankenheimer¹⁵ believes adiposis dolorosa to be a dystrophy, and compares it to acromegaly, the former affecting the adipose, and the latter the osseous structures.

While the adipose tissue is affected primarily, changes in other tissue have appeared with sufficient frequency to make the occurrence more than a mere coincidence. Cases with joint involvement have been reported by Dercum,¹⁶ Renon and Heitz, and myself.¹⁷ I have also seen one other case with arthritic changes in the knees and small joints of the hands, producing distinct deformity. A case from the Jefferson Hospital showing imperfectly developed bony structures will soon be placed upon record. There may be, therefore, in adiposis dolorosa, arthritic and osseous as well as

¹⁰ Jour. Nerv. and Ment. Dis., 1900, xxvii, 519.

¹¹ AMER. JOUR. MED. SCI., 1902, p. 991.

¹² Arch. de med. exper. et d'anat. pathol., No. 5, September, 1906.

¹³ Presse méd., Paris, 1904, ii, 594 to 596.

¹⁴ Revue neurol. de Paris, 1904, xii, 630 to 632.

¹⁵ Jour. Amer. Med. Assoc., vol. 1, No. 13, p. 1012.

¹⁶ Phila. Med. Jour., 1902, x, 1007.

¹⁷ Amer. Med., New Series, vol. ii, No. 5, p. 317.

adipose changes. Muscular atrophy has been observed in one case only, in association with neuritis of the large nerve trunks.

The thyroid, affected in seven of the eight cases, at once commands our attention. Considered from the standpoint of the symptoms however, there is a peculiar contradiction. The obesity, anidrosis, and improvement following the administration of thyroid extract suggest hypothyroidism, while the flushing, tachycardia, tremor, and often the anxious mental state suggest hyperthyroidism. The term *dysthroidismus* would seem, therefore, a better one than *hypothyroidismus*, as used by Pineles.

We should not, however, in considering the pathogenesis of *adiposis dolorosa*, neglect the hypophysis. It was found distinctly affected in five of the eight cases, and had been unexamined microscopically in at least two of the remaining three cases. In one instance the thyroid was found to be perfectly normal. Vassale,¹⁸ Ponfick, Kr. Gron,¹⁹ Boyce and Beadles,²⁰ Langhas, Nufice, Dolego, Bourneville, and others have recorded cases with enlargement of the pituitary in *myxoedema*. Lediard,²¹ Lannois, and Pierre Roy have reported cases of *acromegaly* with marked hypertrophy of the thyroid.

It has also been found that in animals, when the thyroid is extirpated, the pituitary enlarges. Hutchinson²² regards the pituitary as a growth centre, which belief is opposed by Guerrini²³ who believes that the secretion of the hypophysis is antitoxic in character, and exerts no trophic influence. Guerrini²⁴ has proved experimentally that the hypophysis reacts to intoxications, either acute or chronic. Madelung²⁵ reports a case of injury to the hypophysis followed by enormous obesity, while Berger²⁶ cites an instance of a tumor behind the chiasm, compressing and flattening an otherwise normal pituitary, with increased obesity, alopecia, and dryness of the skin. Magnus-Levy has found an increased oxidation in *acromegaly*, resembling that which is present in *exophthalmic goitre*. Malcolm²⁷ believes that the "nervous" lobe has a katabolic influence on bony tissue.

It seems, therefore, that sufficient attention has not been given the hypophysis, and I would suggest that etiologically it is of almost as much importance as the thyroid gland. May not the symptom group of *adiposis dolorosa* result from a primary disease

¹⁸ *Rivista speriment. di Freniatria e med. leg. d. alien. ment.*, 1902, xxxviii, fasc. 2, 3, p. 25 to 39; *Revue Neurologique*, June 15, 1903, p. 560.

¹⁹ *Norsk Magazine for Laegendenskabess*, August, 1894.

²⁰ *Jour. Path. and Bact.*, i, 233.

²¹ *Brit. Med. Jour.*, April 4, 1903, p. 789.

²² *New York Med. Jour.*, March 12 and April 2, 1898, and July 21 and 28, 1900.

²³ *Centralbl. f. allg. Path. u. path. Anat.*, March 15, 1905, p. 177.

²⁴ *Archivio di fisiologia*, an II, fac. III, p. 384 to 386, March, 1905.

²⁵ *Beiträge f. klin. Chirurgie*, 1903.

²⁶ *Ztschr. f. klin. Med.*, vol. lxiv, Nos. 5 and 6.

²⁷ *Jour. Physiol.*, 1904, xxx, 270.

of either of those structures, the other being involved secondarily through their close interrelation?

Changes in other structures have been mentioned, especially of the genital organs. Undeveloped testicles have been found in one case and sclerotic ovaries in three cases. Symptoms pointing in this direction are the sterility, loss of sexual power, and hypertrichosis in a female. These changes, however, together with the neuritis of the terminal filaments, appear to be secondary in importance to those in the thyroid and hypophysis.

DIAGNOSIS. A typical case of Dercum's disease should be easy of recognition. The diagnosis should be based chiefly upon the two symptoms—accumulations of adipose tissue, and the presence of pain upon manipulation of these deposits. From multiple neuritis, the diagnosis can be made by the absence of pain and tenderness over the larger nerve trunks, or, when this is present, by the absence of muscular wasting commensurate with the duration and intensity of the pain. In simple lipomatosis there is no pain, and the general symptoms of adiposis dolorosa are absent. In its early stages, the disease has not infrequently been mistaken for rheumatism.

PROGNOSIS. Recovery from adiposis dolorosa is rare, but the disease itself does not directly cause death. Its tendency is usually progressive—often with exacerbations of pain accompanied by increase in size of the adipose deposits. Complete intermissions are rare, but remissions are common.

TREATMENT. The present status of the treatment of adiposis dolorosa leaves much to be desired. At best it is uncertain and unsatisfactory, but by no means hopeless. As in other forms of neuritis, the salicylates are often of value in relieving the pain, and may be advantageously combined with a bromide salt, as the latter tends to lessen the disagreeable effects of the former. Aspirin, being less irritating to the stomach than the ordinary preparations, is often of value. Extract of the thyroid gland, while not a specific, is the most valuable remedy at our command. Several cases have been reported as showing marked improvement following its administration, and Dercum cites one case of cure (the only cure reported) following its use. In my own experience, I have seen five cases distinctly benefited by its administration. It is obvious, however, that the brilliant results obtained in myxœdema, cannot here be expected. The therapy of the pituitary body is at present so indefinite and so little understood, as to make administration of the gland of no practical value.

Potassium iodide should be given whenever there is present a definite history of syphilis, but I have never seen any beneficial results following its administration, even in a case having a specific history.

As the majority of the patients are obese, the heart is likely to be

involved in the general adiposity, and may require attention. More general measures, as massage, electricity, rest, etc., frequently add to the comfort of the patient and should never be neglected.

I regret to say, however, that in some cases, fortunately a minority, the symptoms are unrelieved by any of the various remedial measures that have been recommended. As the years bring us a more accurate knowledge of the normal and pathological chemistry of the secretions of the ductless glands, we may hope for more definite therapeutics, and better results in the treatment of this interesting disease.

I desire to express my indebtedness to Dr. F. X. Dercum for the privilege of reporting the cases, and to Dr. W. M. L. Coplin, for many valuable suggestions.

THE CHEMISTRY OF THE URINE IN DIABETES MELLITUS.

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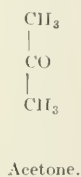
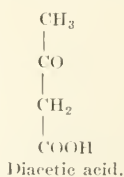
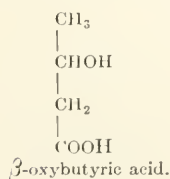
THE history of the case which formed the basis of this study is briefly as follows: M. H., a female, aged seventeen years, was admitted to the Montreal General Hospital, in Dr. Finley's service, on January 6, 1908. The family history was negative for diabetes. The personal history was negative until July 28, 1903, when she had an "interval operation" for appendicitis. The urine during this admission had a specific gravity of 1015 and was negative for both albumin and sugar. She was discharged August 19, 1903, the wound having healed "per primam." Two weeks later she developed typhoid fever, during which the wound broke down. On February 16, 1904, she reëntered the hospital to have the sinus closed. The urine was again negative for albumin and sugar and had a specific gravity of 1022. In March, 1906, the appendix wound a second time broke down, and after a prolonged home treatment she was re-admitted on October 6, 1906; the sinus was excised and the edges freshened. The wound closed very slowly, and on her discharge, on November 17, 1906, had not completely healed. The urine was examined three times during October, 1906, but contained no sugar, though the specific gravity was high (1032, 1030, and 1023). The patient felt perfectly well until June, 1907, when she first suffered from weakness, polyuria, and thirst; these symptoms gradually increased in intensity. During November and December, 1907, she noticed an increase in appetite and a tendency to attacks of som-

nolence which lasted for a day or two at a time. She had lost thirty-one pounds in weight in seven months.

Physical examination revealed a fairly well developed but poorly nourished girl; mucous membrane pale; expression dull and listless, but mind clear. Skin dry and harsh, but no evidence of pruritus. The lymphatic and respiratory systems were normal. The circulatory system was negative except for a somewhat "clicking" aortic second sound and slight thickening of the radials. The tongue was clean and moist; the teeth carious. The breath had a sweet fruity odor. The abdomen was negative except for some tenderness in the right hypochondrium. The eye grounds were negative. The temperature ranged between 99° and 99.2°; pulse, 70 to 96; weight, 98½ pounds.

She was placed on the ordinary ward diet from January 7 to 20. The amount of urine varied between 6050 and 3730 c.c., with an average of 4680 c.c. in the twenty-four hours. The fluid intake was 2640 to 4120 c.c. or an average of 3160 c.c. in the twenty-four hours. The reaction of the urine was strongly acid. The specific gravity was 1035 to 1044, the average, 1031.5. There were evidences of a slight grade of nephritis, as shown by a constant albuminuria and occasional hyaline and granular casts. The sugar content, both by the saccharometer and by Fehling's titration method, was very large. The percentage by the former varied from 6.38 to 9.46 per cent., and by the latter 7.24 to 9.8 per cent.; the amount in twenty-four hours by Fehling's method averaged 370.6 grams, with a maximum of 495.5 grams and a minimum of 278.3 grams. This is, of course, a large amount of sugar, and shows a considerable derangement of the carbohydrate metabolism.

The Acetone Bodies. It must be borne in mind that normally acetone occurs in the urine in small but detectable amounts (0.01 to 0.05 gram in twenty-four hours). Acetone is an oxidation product of diacetic acid, and this in turn of β -oxybutyric acid. A glance at their structural formulæ will be useful.



It is now generally conceded that the acetone bodies originate chiefly from the lower fatty acids of the organism and of the food. They may arise from proteid (leucin) to a very slight extent. Their excretion in the urine (known as ketonuria) occurs in the absence of normal carbohydrate metabolism; neither the largest intake of fats nor the greatest increase of fat destruction in the body will lead to a ketonuria, as long as sufficient carbohydrates are breaking down.

The daily combustion of 80 to 100 grams of carbohydrates is sufficient to prevent it. The carbohydrates provide the oxygen necessary for complete oxidation of fat into CO_2 and H_2O ; deficiency of carbohydrates causes a defective oxidation in the tissues, hence defective fat metabolism with resulting acetone formation. Normally there is excreted 0.01 to 0.05 gram of acetone, but if carbohydrates be withdrawn the acetone increases twenty to fifty times and both β -oxybutyric acid and diacetic acid may appear in the urine. When the ability of the organism to attack the circulating carbohydrates has received a severe injury, when all carbohydrates of the food re-appear in the urine, when the greatest portion of the sugar arising from the albumin is excreted, then the typical ketonuria occurs. Ketonuria is a useful measure of the intensity of the diabetes; thus, in the first stage of diabetes acetone only occurs; in the second stage both acetone and diacetic acid, and in the third stage all three bodies appear. Further, much acetone is excreted by the lungs, giving the characteristic fruity odor to the breath.

Estimation of Acetone and Diacetic Acids. The usual method is that of Messinger-Huppert, based upon Lieben's observation that acetone when treated with iodine in solution gives rise to the formation of iodoform. This method determines both acetone and diacetic acid, as the latter is decomposed by 100°C . into acetone and CO_2 . Our patient showed a great excess of both these bodies, varying from 3.8793 to 1.2143 grams, or an average of 2.907 grams in twenty-four hours. Von Noorden states they seldom exceed 5 to 6 grams, though rarely 7 to 8 grams have been observed. Gerhardt's ferric chloride test for diacetic acid was positive on the first two days only.

Estimation of the β -oxybutyric Acid. This was carried out as recommended by Pavy. This acid is levorotatory, while glucose is dextrorotatory, therefore one counteracts the other, causing a considerable discrepancy between the sugar as determined by the saccharometer and that by Fehling's titration. The latter gives the true amount of glucose, while the former gives the excess of glucose over the levorotatory oxybutyric acid. The difference between the two readings gives the amount of the acid in terms of glucose. To express it in terms of oxybutyric acid (which has an optical activity of 24.1° as against that of glucose of 52.5°) one multiplies the difference by 2.2. This method is open to error from the presence of other levorotatory bodies, as levulose, and is not as exact as the direct chemical methods of Darmstaedter and others. Nevertheless, it was found that the acid varied in amount from 98.96 to 33.76, with an average of 61.424 grams. It is not uncommon to find 60 to 70 grams of this acid in the twenty-four hours; it may even exceed the sugar in amount.

Nitrogenous Bodies. The total nitrogen of the urine was estimated by the Kjeldahl method and was found above the upper limits of normal (10 to 16 grams), ranging from 14.4155 to 18.4703, or an average

of 16.8232 grams. This increase is physiological in diabetes, and is due to the great increase of proteid ingestion, which is often more than 180 to 200 instead of the normal 90 to 100 grams. It becomes pathological, when, in addition, the body albumin is excreted, which occurs with a high sugar output. The nitrogen loss is greater the more the general nutrition is injured by the glycosuria; it is small when the food contains enough albumin and much fat. The toxic bodies of coma cause much nitrogen loss.

The urea is increased for the same reason as the total nitrogen, and was found to range between 37.3 to 61.65 grams, with an average of 42.93, as compared with the normal limits of 20 to 40 grams.

The uric acid is normal or slightly increased. Our patient excreted 0.1979 to 0.6714, or an average of 0.3783 gram, while normally it varies from 0.2 to 1.5 grams. The extractives, kreatinin, etc., were not estimated.

Ammonia. The NH_3 content is most important and was estimated by Schaffer's modification of Schlösing's method. This is by no means an ideal method, and has a considerable error when compared with Folin's procedure. Normally the urine contains 0.5 to 0.1 gram, but may reach 1.2 to 1.5 grams on a meat diet. Our patient showed 4.8698 to 3.8847 grams, with an average of 4.251 grams during the first four days. In diabetes 3 to 6 grams is common, and there is a case in literature which excreted 12 grams in the twenty-four hours. The high values of NH_3 occur in the severest cases and especially in diabetic coma. It is an attempt on the part of nature to protect the "native alkalinity" of the tissues from the acidosis present. It will be remembered that the sulphur and phosphorus of the proteids are oxydized into H_2SO_4 and P_2O_5 . Normally these acids encounter sufficient fixed bases to neutralize them, but when they are in excess they have to attach themselves to a portion of the NH_3 , which is at the same time produced by proteid destruction, and in this state pass into the urine. Normally the NH_3 in the urine is small, for it combines with the CO_2 to form urea, but when NH_3 is combined with sulphur or phosphorus it cannot also combine with CO_2 . Further, when diacetic and oxybutyric acids are present they carry off still more NH_3 . Another point of interest is that the relation of the nitrogen of the NH_3 to the total nitrogen is much increased in diabetes and often forms 10 to 20 per cent., instead of the normal 2 to 5 per cent. In our case the NH_3 nitrogen formed 20.8 per cent. of the total nitrogen. In conclusion, the ammonia determination gives an accurate estimation of the acidosis present and one more easily arrived at than the direct estimation of the acidosis itself.

Treatment. The only treatment during the first two weeks was the administration of a pill of opium, one-half grain, three times a day. On January 21 the patient was placed on a strict von Noorden diet plus 120 grams of bread; after two days the bread was reduced to 100 grams. This dietary was given to January 25, when it was discon-

tinued on account of weakness and drowsiness being complained of by the patient.

The Urinary Findings. The quantity fell to 2015 c.c. on the third day and remained about that point for three days, though the fluid intake was but little restricted, being about 2300 c.c. The amount of sugar fell on the third day to 20.15 grams, but rose again to 92.39 on the fourth day. The acetone fell to 2.0189 grams on the fourth day, when the diacetic acid re-appeared. On the fifth day the acetone had risen to 4.06 grams and the diacetic acid was still present. β -oxybutyric acid, which had fallen to 34.5774 grams on the third day, rose to 54.67 grams on the fifth day. The NH_3 showed little change on the third day, being 3.6858 grams, but on the fifth day it rose to 4.195—the highest point observed since the second day after admission.

As diabetic coma was threatening, as shown by the patient's general condition (weakness and somnolence) and the urinary findings, the strict diet was discontinued, with an immediate improvement in the symptoms, the disappearance of the diacetic acid, and a drop in the β -oxybutyric acid and ammonia, though the acetone rose still more, to 4.69 grams. Now the object of a carbohydrate-free diet is to restore the metabolic equilibrium of the patient's organism, which has been upset by the toxic effect of the abnormal presence of sugar in the system; by the removal of this influence metabolism may return to its orderly mode of procedure. It must also be remembered that upon withdrawal of carbohydrates, even in health, a small amount of the acetone bodies appears in the urine, which after a time gradually disappears. Hence there is a constant and real danger in the treatment of severe cases of diabetes from the too sudden withdrawal of carbohydrates. Last year I saw a patient who died in coma developing on the fifth day after the institution of a strict carbohydrate-free dietary. Upon the day of his death the urine contained 255.36 grams of sugar, 3.9639 grams of acetone, and 67.54 grams of oxybutyric acid. I cannot state positively that the onset of coma was due to the strict diet, for the case was a very severe and very acute one, but from the experience of others there is a very strong presumption that the onset of coma was at least hastened. Unfortunately for my contention, I had no opportunity to make the necessary determinations before the onset of coma.

It cannot be too often and too strongly emphasized that in severe cases the withdrawal of carbohydrates must be done cautiously and a simultaneous careful examination of the urine made. Hence a patient should be in a hospital with a clinical chemist in the laboratory, or the physician should himself be in a position carefully to watch the urine for signs of ketonuria, which may be present for days before coma supervenes. The various points to be emphasized in carrying out a von Noorden diet can be best illustrated by the following account: After the warning received, the patient was left on a

full diet and was given large doses of sodium bicarbonate until April 1, when a strict diet plus 100 grams of potatoes plus 150 grams of bread was given. This represented in units of energy 2000 calories. Now, for a healthy girl of her weight, 100 pounds, or 45.4 kilograms, there is required for proper nourishment when at rest (45.4×35) 1600 calories; hence she was getting an apparent excess of her needs of 400 calories. But she was excreting 269.9 grams of sugar, that is, a daily loss of 1100 calories. The diet then had for her the value of 2000—1100, or 900 calories. Since the nutritional demands were 1600, there was an actual deficit of 700 calories. In other words, the body was consuming for the necessary supply of heat and energy a daily value of 700 calories. The substance consumed was body fat, as shown by the loss of two pounds in weight. This was not ideal, and, therefore, the proteids were almost doubled, with the result that she held her weight for the next three days. One must always be careful that the caloric value of the food is sufficient to meet the needs of the organism, due allowance being made for the loss of energy by the sugar excretion.

Date.	Diet.	Calories.	Body weight pounds.	Fluid intake c.c.	Amount urine c.c.	Specific gravity.
Normal.		1600			1200	1015-1025
Jan. 7-20	Ward.	.....	98½	3160	4680	1037
Jan. 23	Strict + 100 grams bread.	2600	98½	2240	2015	1018
Jan. 24	Strict + 100 grams bread.	2600	.....	2240	1905	1034
Jan. 25	Strict + 100 grams bread.	2600	96½	2360	3180	1032
Jan. 26	Ward.	.....	.....	2740	5110	1030
March 31	Ward.	.....	98	1000	2970	1033
April 3	Strict + 150 grams bread + 100 grams potatoes.	2000	95	1200	1680	1037
April 14	Strict + 75 grams bread + 100 grams potatoes.	2230	92¼	1300	2990	1037
April 21	Strict + 25 grams bread + 100 grams potatoes.	2750	93½	1300	905	1031
April 28	Strict.	2700	93½	1300	1220	1038
May 1	Strict + 100 grams bread.	3160	94¾	1000	910	1038
June 3	Strict + 100 grams potatoes.	2700	98	2020	1820	1026
June 5	Strict.	2660	99	1700	2160	1038
June 7	Vegetable.	3490	100	1790	1880	1035
June 11	Oatmeal.	2910	105¼	1220	3360	1034
June 14	Strict.	2660	104¾	1080	3610	1035
June 17	Vegetable.	3450	105½	940	2770	1036
June 20	Oatmeal.	2590	105	1040	2215	1028
June 26	Strict + 100 grams bread.	2885	105¾	1000	2260	1031
June 30	Strict + 50 grams bread.	2770	108	1360	3060	1030
July 3	Strict + 60 grams Na ₂ CO ₃ .	2770	108	1220	3030	1027
July 5	Strict + 60 grams Na ₂ CO ₃ .	2770	113	1340	2460	1031

Date.	Sugar by Fehling.	Sugar by saccharo- meter.	Acetone plus diacetic.	Diacetic acid.	β -oxy- butyric acid.	Total N, grams.	NH ₃ , grams.	Urea, grams.
Normal.	0	0	0.01-0.05	0	0	10-16	0.5-1	20-40
Jan. 7-20	370.6	342.68	2.907	x	61.424	16.82	4.251	42.93
Jan. 23	20.15	4.43	2.533	0	34.577	19.09	3.685	37.28
Jan. 24	92.39	71.24	2.018	x	46.52	15.22	2.887	34.77
Jan. 25	199.75	174.9	4.065	x	54.67	20.87	4.195	47.7
Jan. 26	304.04	281.05	4.694	0	50.56	19.53	3.023	45.9
March 31	269.97	235.22	1.372	0	76.44	...	2.019	...
April 5	118.27	92.40	2.430	x	56.91	11.14	2.810	26.88
April 14	142.32	105.24	5.527	xx	81.56	...	...	...
April 21	22.89	16.92	0.894	x	13.14	11.20	2.547	19.91
April 28	21.71	16.10	0.592	xx	12.34	17.48	...	34.16
May 1	46.865	42.04	0.220	0	10.61	11.91	1.120	22.95
June 3	26.75	12.01	1.700	xx	32.43	...	...	...
June 5	73.87	57.02	1.240	xx	37.06	...	...	...
June 7	94.94	78.58	1.741	xx	35.41	...	...	...
June 11	220.75	206.97	2.488	0	30.30	9.78	4.889	23.52
June 14	277.60	238.26	3.197	x	86.56	16.07	6.137	36.10
June 17	173.12	158.44	2.507	?	32.29	10.39	3.239	24.93
June 20	119.05	107.20	1.821	0	26.06	9.11	3.690	21.04
June 26	126.78	109.38	2.242	0	38.28	14.55	3.447	33.90
June 30	165.85	134.64	4.912	xx	68.66	18.02	3.641	41.30
July 3	168.16	146.65	2.566	0	47.32	17.13	3.852	...
July 5	114.88	92.00	2.236	0	50.33	8.33	3.228	27.3

x = Good reaction.

xx = Marked reaction.

? = Doubtful reaction.

The aforementioned diet was maintained for three days; then 25 grams of bread was withdrawn; this was repeated at intervals of three days, until by April 23 the patient was getting no bread and but 100 grams of potatoes. After the usual period of three days the potatoes also were withdrawn. To make up for the loss of calories by this carbohydrate withdrawal the proteids and fats were increased to almost three times the original amounts, so that she was getting from April 22 to May 1 about 2650 calories, that is, an apparent excess of 1000 units, while she was losing on an average (58×4.1) 240 units, hence she was getting 760 calories above the requirement of even her disordered metabolism. As a result, she held her weight remarkably well, weighing, thirty-one days after the institution of the diet, $94\frac{3}{4}$ instead of 97 pounds, that is, a loss of $2\frac{1}{4}$ pounds. The amount of urine fell gradually from 2800 c.c. on April 1 to 905 c.c. on April 21, again rose slightly to 1300 c.c., to fall once more to 910 c.c. on May 1, that is, to less than one-third of its original volume, though the intake of fluids was only reduced from 1200 to 1000 c.c. in twenty-four hours. As might be expected, the specific gravity of the urine showed little change, varying between 1031 and 1038.

The sugar fell from 269.973 grams on March 31 to 21.716 grams on April 28, the third day of the carbohydrate-free diet. The patient, though showing a markedly diminished sugar excretion, never became "aglycosuric;" she "manufactured bricks out of straw," or, more truthfully, she was manufacturing carbohydrates from her own tissues. Only the severest type of diabetes remains glycosuric under strict dietary, and to such a class does our patient belong. It was not considered advisable to keep her on this strict diet longer than three

days. Accordingly she was given 100 grams of white bread on April 29, and it was found that her carbohydrate tolerance had been considerably increased by this cure, as on May 1 she excreted only 46.865 grams of sugar instead of 199.75 grams excreted under similar conditions on January 25, 1908. This is the usual result of the von Noorden diet and the chief aim of the *regime*. This increase of carbohydrate tolerance lasts for some time, and in mild cases may reach such a degree that no sugar is excreted even after the ingestion of large amounts of carbohydrates (300 grams and more).

The effect on the acetone was also observed: At first it rose from 1.3728 grams on March 31 to 2.4303 on April 3, but fell again to 0.5922 gram on April 28. This is the usual course of events if the carbohydrates be gradually withdrawn, that is, first a rise and then a gradual fall as the organism gradually accustoms itself to the altered conditions. The ferric chloride reaction for diacetic acid reappeared and was very marked on April 28. The oxybutyric acid persistently fell from 76.44 grams on March 31 to 12.34 grams on April 28. Upon the addition of 100 grams of bread to the strict diet on April 29, the acetone three days later still further fell to 0.2207 gram, and the oxybutyric acid to 10.6106 grams, while there was no reaction for diacetic acid. The ammonia fell from 2.0196 grams on March 31 to 1.9744 grams on April 27.

As the patient grew restless, she was allowed to return to her home on May 7, with directions to carry out the strict dietary plus 100 grams of bread daily for three weeks out of each month. She was readmitted on May 27 on account of a return of her symptoms. On June 3 she was placed on a strict von Noorden diet with a caloric value of 2660 units. On June 5 the urine showed a change for the worse in quantity (2160 c.c.), specific gravity (1038), total sugar (73.8 grams), and β -oxybutyric acid (37.06 grams). The diacetic reaction remained unaltered and the acetone (1.2 grams) was less than on the first day of strict diet by nearly 0.5 gram.

Accordingly, on June 6 the green vegetable diet of von Noorden was tried. This consists of large quantities of green vegetables (150 grams), the yolks of ten eggs, 225 grams of bacon, 100 grams of butter, bouillon, and coffee with cream. Its caloric value was 3490 units, or an excess above her needs of 1500 calories. She gained two pounds in weight, but while the amount of urine, its specific gravity, and the oxybutyric acid fell somewhat, the sugar (91.94 grams) and the acetone (1.74 grams) increased and the diacetic acid persisted. This was contrary to the findings of von Noorden, who believes that this dietary causes a fall in the excretion of sugar and the acetone bodies.

We next tried the oatmeal cure of von Noorden for three days. It consists of 250 grams of oatmeal, 200 grams of butter, 6 eggs, 150 c.c. of coffee or tea with cream, 120 c.c. of lemon juice, and 50 c.c. of brandy. This has a caloric value of 2910 units, or an excess of 400

calories. There was a striking increase in body weight of $5\frac{1}{4}$ pounds by the third day. The amount of urine was almost doubled (3360 c.c.) and the sugar almost trebled in quantity (220.7 grams). The acetone (2.48 grams) also showed an increase, but the diacetic acid test was negative and the oxybutyric acid showed a slight diminution (30.3 grams). The quantity of ammonia was very large (4.889 grams) and the urea about normal (23.5 grams). As was to be expected, the total nitrogen (9.78 grams) was below normal limits. Here again the urinary findings do not bear out von Noorden's claim that such a dietary is followed by a fall in the excretion of the sugar and acetone bodies. The supposed efficacy of this diet lies in the fact that diabetics bear large amounts of one form of carbohydrates better than small amounts of several carbohydrates. Von Noorden, however, admits that the oatmeal diet is not suitable for all cases; some it benefits and others it actually harms. We then decided to repeat the three dietaries, each for a period of three days. We were very disappointed to find upon the third day of the strict meat diet that the total quantity of urine (3610 c.c.), and sugar (277.6 grams), and acetone (3.19 grams) had still further risen, while the ferric chloride test was again positive and the oxybutyric acid reached its highest point (86.56 grams) at any time during our observations of the case. Corresponding with the acidosis the ammonia was also at its maximum (6.137 grams) in contrast to the total nitrogen (16.07 grams) and urea (36.1 grams). We were at a loss to explain this unsatisfactory result, as no symptoms of coma manifested themselves. It could only be further proof of the severe type of the disease. Our surprise was great, and we felt once more encouraged when on the third day of the second vegetable cure the urine showed the sugar to have fallen to 173 grams, the acetone to 2.5 grams, and but a doubtful ferric chloride test to be present; the oxybutyric acid also fell to 32.298 grams and the ammonia to 3.239 grams. The third day of the second oatmeal cure showed still further improvement in the sugar (119.05 grams), the acetone (1.82 grams), the oxybutyric acid (26.063 grams), while the ammonia remained practically unaltered (3.69 grams).

After another three days of strict dietary the patient was given an additional 100 grams of bread to ascertain whether the carbohydrate tolerance had been increased by these "cures," as had been the case, on her former admission, by the strict von Noorden dietary. On the third day (June 26) there was considerable increase in her toleration for carbohydrates, for the sugar amounted to only 126.78 grams as compared with 277.6 grams of June 14 after the first series of diets; but this increase of tolerance was not as striking as that which occurred in April and May in the early stage of the disease; further, it was not maintained, for by June 30, when there was an allowance of but 50 grams of bread, the sugar rose again to 165.8 grams, the

acetone to 4.9 grams, the oxybutyric acid to 68.66 grams, with a strong reaction for diacetic acid.

It was now decided to watch the effect of the administration of sodium bicarbonate upon the ammonia and acidosis. For the purpose 60 grams of the powder was given in four divided doses in the twenty-four hours. The urine was examined on the third day (July 3) and fifth day (July 5), when the patient was receiving a strict meat diet plus 50 grams of bread. Whereas, under the same diet the oxybutyric acid had been, on June 30, 68.66 grams, it was now 47.328 and 50.331 grams, a slight but definite decrease. The ammonia remained practically unaffected, being 3.6 grams before, and 3.8 and 3.2 grams after the administration of the sodium carbonate.

From a study of the chemistry of the urine during the months of June and July it was evident that the disease was making rapid strides and the usual benefits from diet were not accruing. It was decided, therefore, to allow the patient to return to her home, and a still gloomier prognosis was given.

On September 19, 1908, while I was absent from town, she was again admitted to the hospital. The urine was not so elaborately studied as on previous admissions, but contained excessive amounts of sugar, acetone, and diacetic acid. She was placed on ward diet until September 25, when she was given a strict meat diet plus 50 grams of bread. This caused some diminution in the sugar excretion, but both acetone and diacetic acid were present qualitatively. The bread was gradually reduced to 30 grams by September 30. On September 29 the patient began to feel drowsy and to vomit and to complain of abdominal pain. Suddenly on the night of October 1 there was severe epigastric pain, extreme restlessness, air hunger, vomiting—in short, all the symptoms of rapidly developing coma. The urine showed a diminished amount of sugar, but an increase in intensity of the acetone and diacetic qualitative tests. In spite of an attempt to combat the acidosis by intravenous injection of normal saline and sodium carbonate solutions, drowsiness rapidly set in, the fruity odor of the breath became more marked, the pulse failed, and by 7 P.M. of October 2 (that is, four days after the onset of the first symptoms and less than twenty-four hours after the severer manifestations) she became deeply comatose. For three to four hours immediately after the intravenous injection the patient seemed to improve, but she lapsed again into coma and died at 5.30 A.M. of October 4—eighty hours after the onset of coma.

The autopsy performed seven hours after death revealed parenchymatous nephritis, pulmonary tuberculosis, and chronic pleuritis. The pancreas showed no gross or microscopic change. There was a slight but definite fatty degeneration of the heart, kidneys, and liver.

INTESTINAL OBSTRUCTION: AN OUTLINE FOR TREATMENT BASED UPON THE CAUSE OF DEATH.

A STUDY OF FOUR HUNDRED EXPERIMENTALLY PRODUCED LESIONS.¹

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PHYSIOLOGISTS often quote the sentiments of Montaigne: "With how little anxiety do we lose the consciousness of light and of ourselves." By this they would convey the idea that the act of dying is as painless as the act of falling asleep, and also as little perceived. Nevertheless, so strongly rooted in the human mind is the desire to live, that the profession of medicine has for its chief purpose the lengthening of human life. Hence, it is natural that the study of the causes which bring death to a cell, to an individual, or to a race of men has for long been a favorite and engrossing one. None of us without giving thought can realize how many and how different are the actual and underlying causes which terminate life. "The supreme fact," says Adami, "that sooner or later death comes to all men has profoundly affected all human thought, and the various religions of the world may be regarded as the evidence of man's determination to rise superior to the dissolution of his body." In the unicellular organism there is no destruction of the essential living matter but a multiplication thereof: each spore carries on the life. There is no death in the ordinary interpretation of the word. "It is with the appearance of the multicellular organisms that natural death enters into the world." In the cellular differentiation it comes about that the germ cells are given the inherent power of perpetual life, while the somatic cells, through the elaboration of which the individual organism reaches its final development—side-tracked groups, as it were—are destined to hold and live together for a span and then to undergo dissolution.

There are in general two forms of death which may befall the somatic cell—the physiological and the pathological. The pathological form of death may be induced by mechanical, physical, chemical, or bacterial agents. With these in this paper, which deals with the cause of death in duodenojejunal obstruction alone, I hope to demonstrate that we are not concerned. Physiological death, on the other hand, that form of dissolution of somatic entity

¹ A research conducted under a grant from the Rockefeller Institute for Medical Research, and presented at a meeting of the Johns Hopkins Medical Society, Baltimore, March 1, 1909.

which has been studied so thoroughly, so exhaustively, in the pioneer work from the Johns Hopkins laboratories, the death following parathyroidectomy and that associated with adrenal and pituitary destruction or removal, this physiological form of death is that which immediately concerns us. I understand physiological death to comprise not only the dissolution which follows the removal of certain substances by destruction of their secreting cells, such as the parathyroid, but also that dissolution of somatic life which is brought about by the mechanical interference with detoxication of the normal secretions of the body. Putting it concretely, I may say that a barrier which may prevent the normal distribution of enterokinase, or the normal reaction of anti-enzyme upon enzyme, is the cause of death which is physiological and somewhat of the same type as is the death brought about by removal of glandular secretions, so-called internal in character. It is not to be denied, of course, that these thoughts suggest ascribing to the duodenum a function, I believe, hitherto and as yet unknown, that of internal secretion.

In whatever manner this may be rightly considered, I ask you to allow me to start with the hypothesis that the intestinal barrier which closes the lumen works no ill to the organism save through an interference with the physiological exchange or balance of the duodenojejunal secretions, and that the resulting death is physiological in type. I ask you to assume for the moment—and for this we have adequate proof—that in intestinal obstructions there is no appreciable damage to the individual through the nervous system from the direct trauma of the obstruction; that there is no lethal infection of bacterial origin; that the element of decomposition of food does not enter into the picture at all—in short, that all pathological forms of death are eliminated. I shall strive to detail to you the simple, and withal possibly inefficient, measures which I have taken in my efforts to prove these things to myself.

NERVOUS EFFECT OF INTESTINAL TRAUMA. Clinically surgeons have recognized a difference of degree in the shock produced by cutting the intestine in various places: the nearer one approaches the pylorus, other factors being equal, the greater the shock. Indeed, in the execution of the well-known pyloroplasty operation devised by Finney, it has been, I believe, commonly recognized that a shock to the patient might occasionally be clinically noticeable at the moment of actual section of the pylorus. Operations which will be described later and in the course of which this highly sensitive mechanism was entirely removed or seriously injured, and furthermore operations in the remotely aboral portions of the small intestine which technically were associated with precisely the same amount of traumatism as those in the duodenum and jejunum, afford, under study, point blank evidence that the nervous shock or reaction (let it be called what it may) has nothing whatsoever to

do with the cause of death in the form of intestinal obstruction under consideration. Indeed, I have been led to the conviction that the infliction of even unusual mechanical traumas incident to various operative procedures upon the alimentary canal, not excepting the thoracic œsophagus, is incapable of producing more than a transient and unimportant nervous reaction. It stands to reason that if a dog would live for weeks with iliac obstruction and dies at the end of a few hours with duodenal obstruction, and that if the same dog can be made to live also for weeks, if but the slightest drainage be instituted, something far more important than mere mechanical injury is the cause of death. Obviously the traumatism in each case is equal. Incidentally, it may be noted that whatever nervous traumatism might be associated with the dilatation of the proximal loop, would presumably be greater where the greater dilatation occurred. In the majority of fatal cases of duodenal obstruction, there was little or no dilatation; it rarely has time to develop, whereas in the chronic aboral obstructions it is frequently found.

INFECTION OF BACTERIAL ORIGIN. No one could pretend to read the literature of intestinal obstruction and not be acquainted with the contributions which have been made from the Johns Hopkins Laboratory on the subject of bacterial emigration oral to the obstruction. These studies have contributed widely to our knowledge of the pathological type of death which unquestionably occurs from obstructions in the aboral portions of the ileum and from occlusions of the great gut. It is, however, the physiological form of death alone with which I am concerned; with the fulminating prairie-fire-like toxemias which, unheralded and often in a few hours, destroy the victims of duodenal obstruction. In dogs the clinical syndrome is usually typical; the muscular tremors localized in certain groups of muscles, the tachycardia, the rapidly advancing coma and death, followed by a characteristic stiffness. Clinically this picture is not far different from that observed after parathyroidectomy.

The pathological form of death which results from obstruction at or near the ileo-cecal valve and which may well be of bacterial or stercoraceous origin, has not been the special object of our study, and of it, therefore, I am not qualified to speak. I would note, however, in passing that it is slow and tortoise-like in overtaking the somites, suggesting in every detail a process quite different from that which has been the special subject of my studies. Furthermore, it should be noted that while the duodenum possesses a rich flora, it is exceedingly poor, at least in the healthy dog, in pathogenic forms, and continental observers, as well as your own, have found blood cultures taken from cases of duodenal obstruction entirely sterile.

With these premises then I ask you, for the academic purposes

of argument, to assume that in obstruction of the intestine two entirely separate and distinct forms of death are to be differentiated: the one duodenal and purely physiological, due to an unknown disturbance of the duodenal secretion or balance, the other ileo-colic and purely pathological; the one a true auto-intoxication, the other a true exo-intoxication.

DUODENAL AUTO-INTOXICATION. The following impressions have resulted from the study of over 400 cases of duodenal or oro-jejunal obstruction produced experimentally during the past five years at the Surgical Research Laboratory of Columbia University. Although the series is not small, the positive conclusions which are offered by it are regretfully small. This may be attributed in part to the natural deficiencies of the experimenter and to the great intrinsic difficulty of the task, and also very fairly in part to the fact that the work has been done at odd moments taken from an annoyingly engrossing practice and amid surroundings sadly incomplete and unfit. I mention this because I seek your indulgence.

A chronicle of the steps which have led to the above outlined position on intestinal obstruction is as follows: About five years ago, while modifying the McGraw elastic ligature so as to substitute common every-day twine for the perishable elastic, and also with a view to remove sizable apposed portions of gut and stomach wall, Dr. Weir at the time considering this a necessary part of the technique, we were suddenly confronted by the perplexing coincidence that all our animals died. There was no peritonitis; there was no gross lesion discoverable within or without the abdomen. We noted an early rigor mortis, and that before death the heart beat was accelerated, the gait was peculiar, owing to spasticity of the hind legs, and there were well-defined muscular twitchings. The technique had embraced the closure of the duodenum (Fig. 1). At that time no information was forthcoming as to the cause of these phenomena and I could find nothing regarding it in the literature. It was not long, however, before Roger, in France, began an allied series of experiments which to some extent corroborated our own findings. All these experiments, as well as the most recent ones, have been based on the utilization of this potential gastro-enterostomy by the twine triangular ligature as a control. It seems reasonable, and indeed is easily susceptible of proof, that the twine will cut out and give drainage in healthy stomachs of normal dogs at about a constant time, seventy-two hours. It is a coincidence of import that the physiological death which we have been studying usually takes place in about the same time as is necessary for stoma drainage to begin. Thus we have come to regard the cutting out of the stoma as a sort of index of resistance of the individual to the intoxication process, and we have proceeded to create different degrees of toxicity, which we found we could do by varying the position of the obstruction and of chronicling the results in terms

of gastric drainage. For it should be noted that almost any form of drainage, whether through the normal channel of the gut, or abnormally through the stomach or even through an entero-anastomosis of the aboral loop with the oral loop, will counteract the lethal effects of what we believe to be a physiological death, due to a disturbance of physiological intra-enteric enzymotic balance.

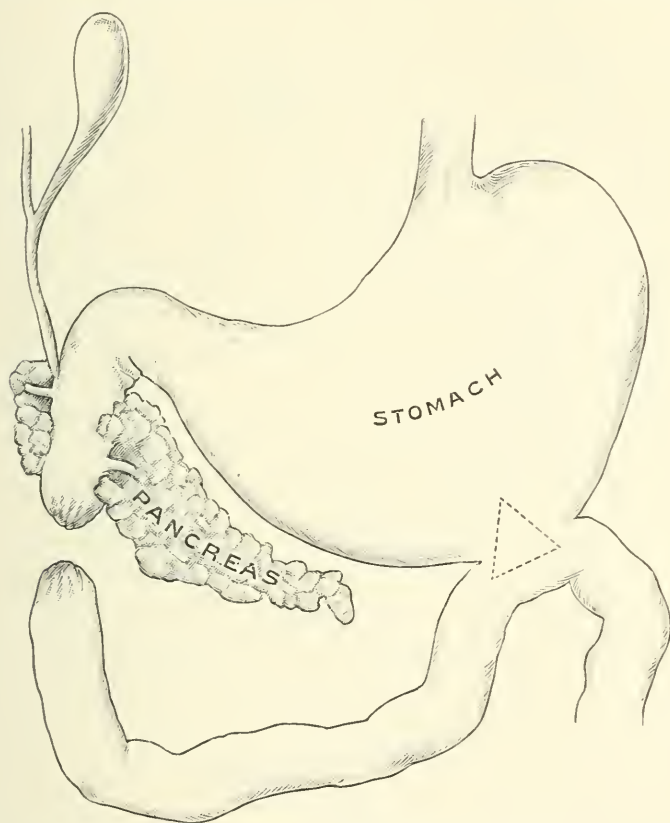


FIG. 1.—Duodenal obstruction; twine triangular control. In this class of experiments the bile and pancreatic fluid do not drain. Death before stomach drainage almost invariably occurs irrespective of the presence or absence of food in the stomach. This short-loop type should be given retrograde lavage or anti-enzyme serum from the long-loop class.

DETERMINATION OF ABORAL LETHAL LINE FOR PHYSIOLOGICAL DEATH. Logically the first step after determining by a long series of experiments that death followed the closure of the duodenum before drainage became established through the triangular stoma, was to ascertain the effect of practising a similar technique, but modified by placing the obstruction in the jejunum (Fig. 2). Another lengthy series of experiments determined, I believe with reasonable accuracy, that death would not occur in a medium-sized dog until

after the free drainage of the stomach, that is, several weeks, in any case when the obstruction lay more than 35 cm. aboral to the pylorus. This distance probably varies somewhat according to the size of the dog. The individuals exposed to this type of experiments will in future be referred to as the "long-loop dogs." For to them on account of the possible production of anti-enzymes, or protective

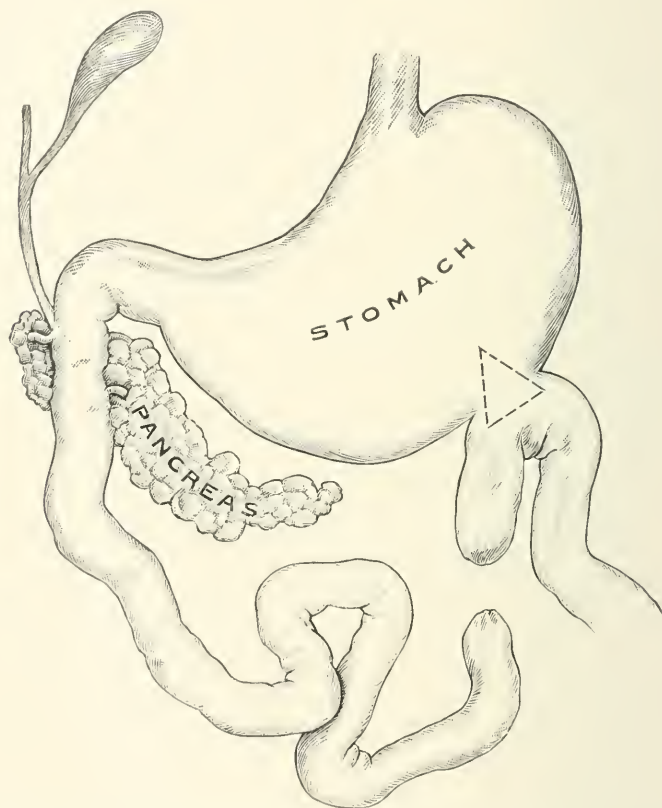


FIG. 2.—Jejunal obstruction. The length of the oral loop was more than 35 cm. In this class of experiments the dog lives until the twine cuts the stoma and often for months thereafter. Obstruction between this (35 cm.) and the greater pancreatic duct is almost always fatal before gastric drainage begins. Does the intestine detoxicate by the addition of an anti-enzyme, or does it save life by offering a larger field for absorption, thus diluting the toxic elements? This long-loop class may furnish a protective anti-enzyme serum for use in the short-loop class.

bodies of unknown character, there attaches a particular and perhaps a lasting interest. These long-loop dogs, barring ordinary accidents, survive the moderate toxemia to which the obstruction gives rise and will live often for several months without apparent discomfort or loss of body function. On autopsy, the oral segment was found to be but moderately dilated, as a rule, and the evenness

of digestive function suggested the phenomenon of gastro-proteid digestion. But the theoretical considerations which offer themselves as a result of this particular group of experiments must not interfere with this chronicle of plain observed facts.

DETERMINATION OF ORAL LETHAL LINE FOR PHYSIOLOGICAL DEATH. The next step naturally was to determine the oral limits of the point of obstruction beyond which one might go and not encounter physiological death within the time limit of triangular control. Because of the studies of Roger upon the gastrotoxins, and of the recent publication of Bolton describing a gastrotoxic serum, it is of very great importance to know whether the lethal bodies take their origin from the gastric mucosa, from the pancreatic fluid, or from the duodenum. Roger states that simple ligation of the pylorus leads to this physiological death in from seventy-two hours to five days. That, it will be observed, is just without the limit of the twine triangular time control. It is true that Roger did not employ the delayed gastro-enterostomy for a control, and so much that is accidental is certain to enter into all this sort of work that one feels hesitancy either in commenting upon the results obtained by others or impressing one's own experimental findings. It is true, however, that we have observed this fact: Given free drainage of the duodenum through the normal channel, as shown in Fig. 3, the stomach may be obstructed at or near the pylorus more frequently without lethal result until the cutting through of the triangular stoma than if the obstruction were in the duct-bearing portion of the duodenum. Of course, in this type of experiment, with the cutting through of the stoma, there ceases at once to be a reason why the animals should not live for an indefinite period. I do not wish to be understood as saying that no physiological toxic elements arise from the stomach and that the source of the toxicity is strictly duodenal or pancreatic; but we have been struck by the fact that, discounting all consideration of biliary toxemia, which one seems quite justified in doing, at least the chief source of the poison is either in the duodenum or the pancreas. In the light of our present knowledge, and measuring the degree of toxicity by our time drainage unit, rather than attempting to measure it, as Roger has done, in terms of toxic units, we were led to assume that the source of the toxemia was not in the stomach but in the duodenum. This enabled us, for purposes of study, at any rate, to place the oral limit of the lethal line between the pylorus and the papilla of Vater, because until now the question of the influence of the bile has not yet been worked out.

The duct-bearing portion of the duodenum has long been recognized as an area having unknown and profoundly complex physiological properties, and it is in part the object of this paper to demonstrate that the most accurate interpretation and knowledge of the physiological processes going on in this short tube must form

the groundwork for future therapeutic progress, be it surgical or medical; not alone on the alimentary canal, but as one should logically expect, as well upon its great glands, the liver and the pancreas. The morphological relationship of the stomach, liver, and pancreas to the duodenum has been graphically portrayed by Mumford, who says that the pancreas, the liver and ducts, and the stomach hang like three apples on a single stem, the duodenum. Whatever affects one often affects the others. What more striking

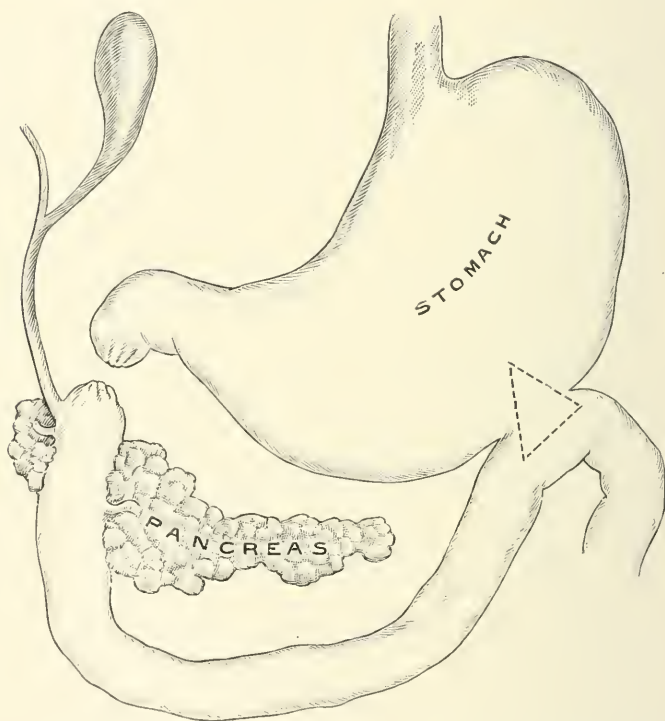


FIG. 3.—Duodenal obstruction; twine triangular control. Both the pancreatic fluid and the bile empty into the aboral loop. In this class of experiments there is usually no fatal outcome during stoma control, even if the stomach contains food at the time of the operation.

simile could one have? I submit that our studies have carried us still farther and that we are justified in considering not only the morphological relations, but the physiological relations as fixed. Is it not significant, in view of the close morphological relationship of these organs, that we have from unknown causes fatal hemorrhages into the pancreas, fatal dilatation of the stomach, fatal sequels to biliary operations which are not properly drained? I leave the discussion of this to those present more qualified to speak of it than I, and continue with the narration of our experimental observations.

ELIMINATION OF THE BILE BY DUCT LIGATION; CHOLECYSTENTEROSTOMY AND TRANSPLANTATION OF THE POINT OF DISCHARGE INTO THE DUODENUM. A long series of experiments, painful to the operator in point of technical detail, was created by which the bile was intended to drain into the ileum by the use of the ordinary suture opening between the gall bladder and the gut. For some reason, however, although the technical part was accurately executed, there

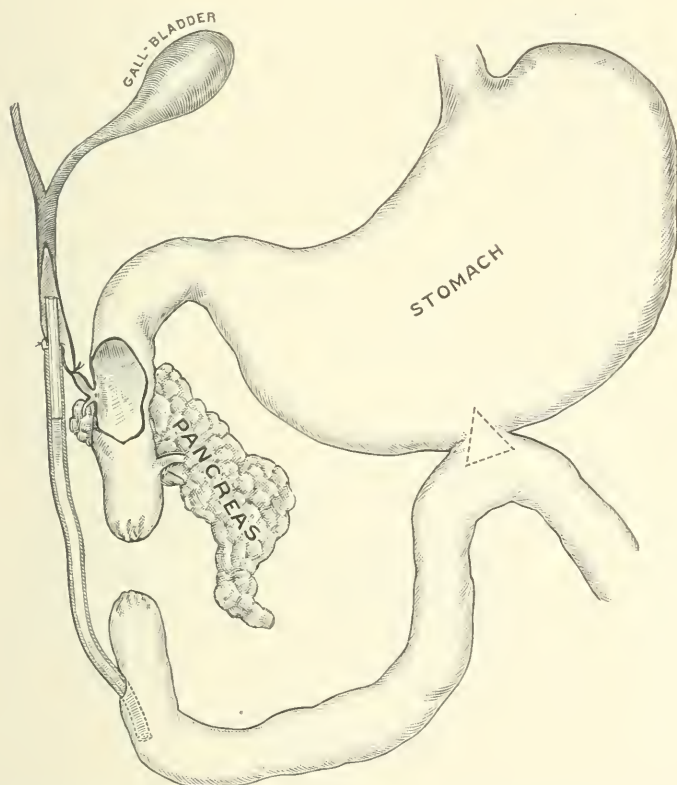


FIG. 4.—Extra-enteric transposition of the biliary secretion (Sullivan's technique). A glass cannula is inserted in the common bile duct; a rubber tube over the glass is stitched to the cut margin of the duct and introduced within the gut aboral to the intestinal obstruction. The bile duct is tied at the entrance to the duodenum.

was in every case a failure of the bile to drain. We finally concluded that there was either a change in its composition, owing to infection from the ileum, or that the secretory function of the liver cells had been abandoned or changed to an absorptive one. In any event, the bile draining or not draining, it was not possible for it to enter the oral loop, as the common duct had been ligated and divided, but the results, so far as the physiological death went, were the same. Death occurred in short-loop dogs before stoma-control

drainage. To fortify the position and to enable us to feel that we were not superimposing hepatic changes upon those under consideration, Mr. Arthur Sullivan, the senior laboratory assistant, devised means for the direct transplantation of the bile (Figs. 4 and 5). It comprises the reconstruction of the common bile duct, and will form the basis of a communication from him at a later date. The use of this simple and effective technique allowed of sufficient room between

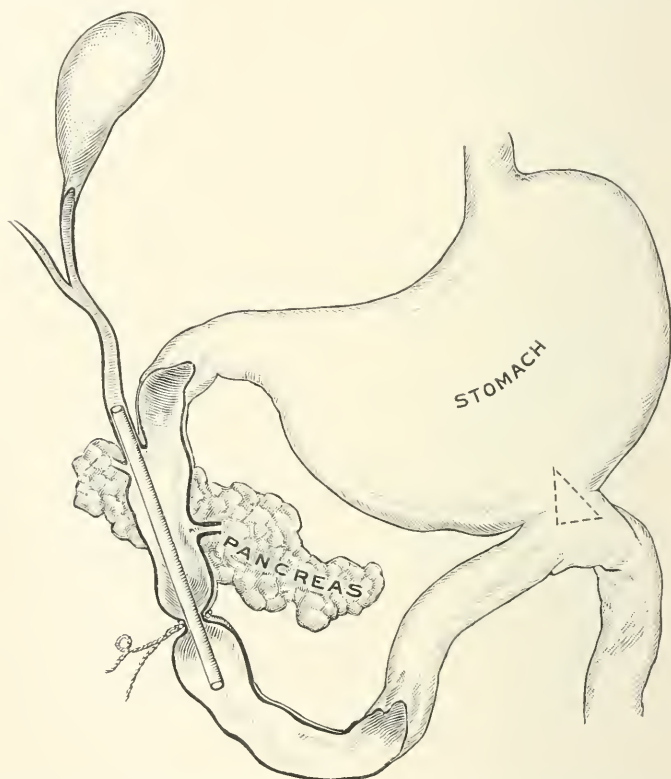


FIG. 5.—Intra-enteric transposition of the biliary secretion; twine stoma control. The forepart of the gut is shaved off to show the tube in position. This technique is difficult of execution and is further objectionable in not permitting actual section of the gut at the point of obstruction. There is apt to be leakage of the intestinal contents around the tube. This vitiates the experiment.

the transplanted biliary intake and the greater duct of the pancreas, either for complete section and invagination of the duodenum, or its ligation, as the case might be. Here, again, a sufficient series of experiments demonstrated that the supposed toxicity of the bile, at least in regard to obstructive death, was erroneous. It did not matter whether the bile emptied into the oral (Fig. 6) or aboral loop near the point of obstruction, whether the duct was simply ligated and cut, or whether cholecystileostomy was done, the lethal

outcome appeared rather conclusively still to be dependent entirely upon the position of the obstruction. In other words, bile, the salts of which are known to possess a very measurable degree of toxicity, was in no way connected with the physiological death under observation.

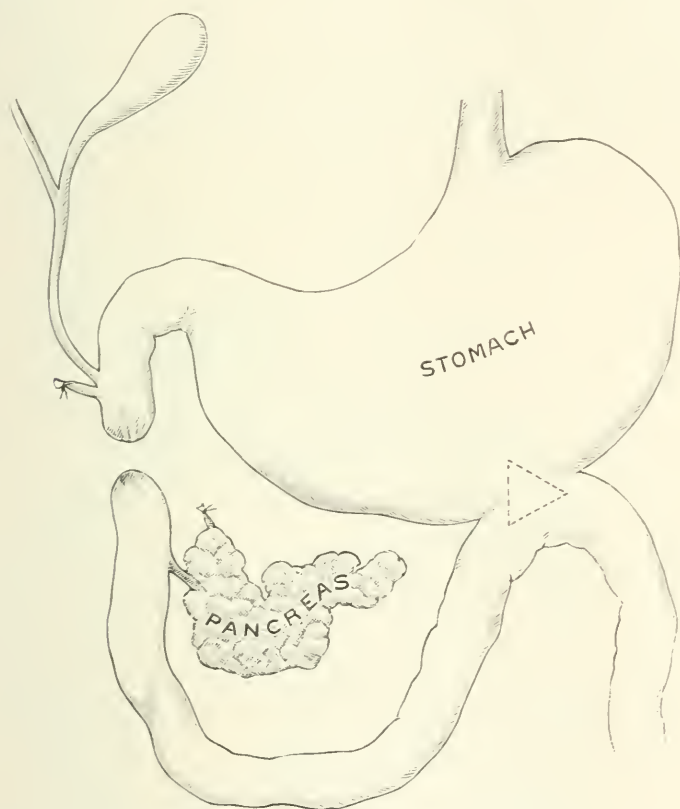


FIG. 6.—Duodenal obstruction between the pancreatic ducts; twine stoma control. The duct of Wirsung is tied and cut so that bile alone enters the oral loop. Drainage of the pancreas by the greater duct is adequate to prevent undue hardening or fat necrosis. The gland continues macroscopically in good condition. Dogs usually live during the period of stoma control!

RELATION OF THE PANCREATIC SECRETION TO INTESTINAL OBSTRUCTIVE PHYSIOLOGICAL DEATH. The morphology of the parts does not allow a transposition of the pancreatic secretion, in the first place, because there are two ducts, and in the second place, because they are very short and firmly fixed to the pancreatic tissue (Fig. 7). Any interference with this, no matter however delicate, may lead to fat necrosis and other conditions which confuse the point of issue. By using Sullivan's tubes, however, we were able to move the point of entry of the bile as many centimeters aboral to the papilla of Vater as was convenient. After ligating the lesser

duct at its point of entrance beside the papilla and cutting it, we could make certain of having sufficient room to sever and invaginate the duodenum in such manner that all the pancreatic secretion might enter into the oral or the aboral loop. Opie has commented on the fact that drainage of the greater duct would usually suffice to prevent any undue hardening of the pancreatic gland because of retained secretion, and we have been glad to make use of his observation by tying and cutting the lesser duct. The result of these studies was conclusive in one regard: irrespective of the whereabouts of the discharged bile, the dogs lived during stoma control

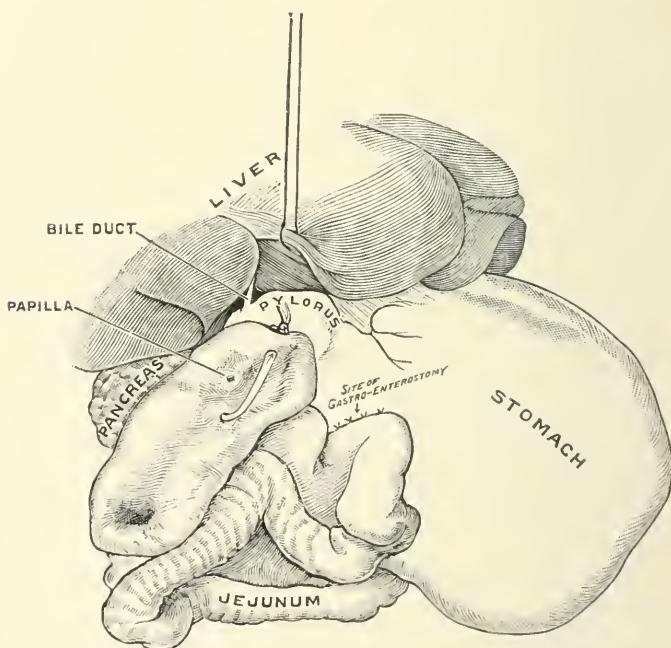


FIG. 7.—Attempted transposition of the pancreatic secretion oral to the duodenal obstruction produced by a ligature. The bile drains aborally. The lesser pancreatic duct is ligated.

when the pancreatic secretions drained aborally, and they died during stoma control when it was confined in the oral loop. I ask that this be not interpreted too positively, because enough conclusive work has not yet been done to justify too positive conclusions. This may well be pardoned, because of difficulties arising from the excessive sensitiveness of the duct-bearing portion of the duodenum, but we have gone far enough to justify our asking for corroborative evidence from others.

We understand that the secretions of the gastric mucosa may be toxic and that this toxicity may be increased many thousands of

times by an oral intestinal obstruction, but we have accomplished enough strongly to suggest at any rate that, whatever may be the nature and degree of this toxemia, a toxemia which develops from a disturbance in the duct-bearing portion of the duodenum contains poisons of a much graver nature. It is presumably not to be

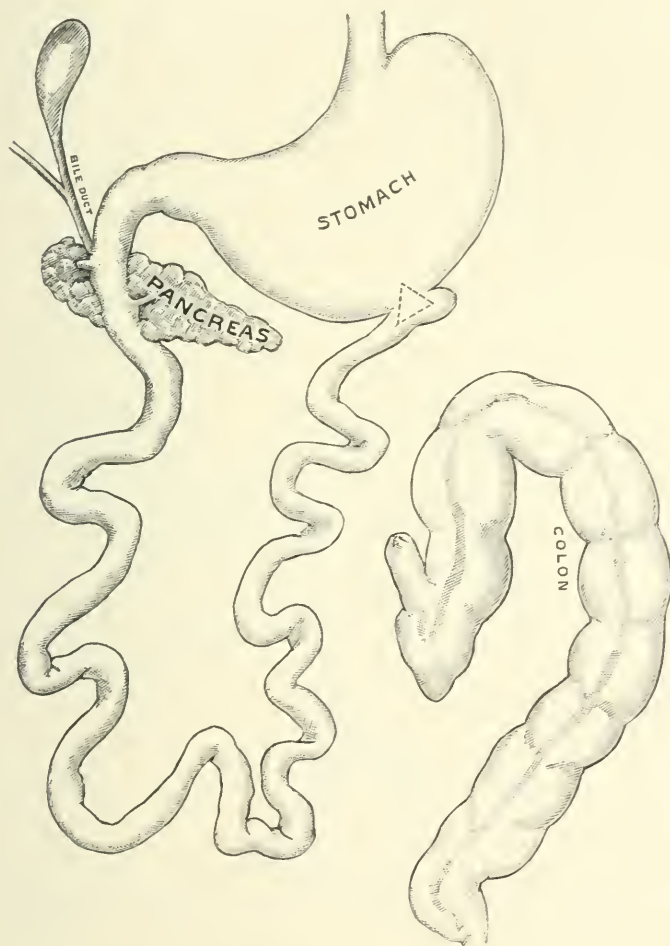


FIG. 8.—The entire small intestine forms the loop. The dogs lived several weeks.

denied that the increase in amount of gastrottoxins noticed after pyloric obstruction may well be brought about by the interference of a normal duodenal limitation of such toxin development. It is a point of perhaps more than academic interest that Weinland has found an antitryptic ferment to exist in the oral portion of the small intestine. Is one justified in supposing that, as the pancreatic

juice, grossly at least, appears to be the lethal agent, the danger from intestinal obstruction grows less and less the farther one places it from the pylorus, and therefore more and more in the antitryptic bearing portions of the canal, and this because of zymotic action. I do not wish to be understood as stating or even suggesting that trypsin alone or as such is responsible for the phenomena; no doubt there are many other ferments and antiferments occurring in the duct-bearing portion of the duodenum, but I speak of the

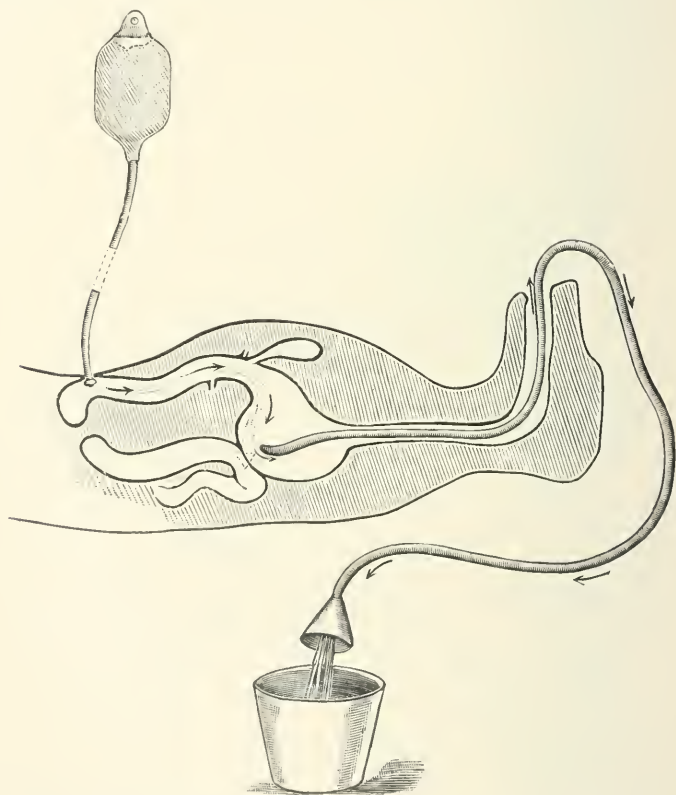


FIG. 9.—Retrograde lavage in a dog. This removes the toxic duodenal products quicker and more thoroughly than ordinary lavage.

trypsin simply as a representative of the class, because I understand its antibody to have been definitely found. It may indeed be that there is some form of internal secretion produced by the duodenum, possibly not directly associated with the processes of digestion, which is the fundamental factor in causing this physiological form of obstructive death. This should be capable of demonstration by experimental methods. Some such hypothesis is at present necessary in order to explain the singular phenomenon of the protective

power of the first 35 cm. of the intestine, the presence of which in the oral loop sufficing to prevent death before the opening of the triangular control. It may also explain the curious conditions shown in Fig. 8.

THERAPEUTICS. So far the suggestions as to treatment for these dogs have been based upon the belief that we had shown the region of maximum toxicity to be the duodenum rather than the stomach. It seemed, therefore, logical to irrigate the entire region rather than the stomach alone, and this by a sort of retrograde flushing (Fig. 9). This in a dog is easy to accomplish, the pyloric sphincter offering no obstruction either to alkaline or to acid irrigation. It is conceivable that some modification of this method might possibly be employed upon the human being, for constant irrigation of the duct-bearing portion of the duodenum would seem on experimental grounds to be the one logical method of preventing the absorption of the physiological poisons referred to.

A more philosophical method of meeting the conditions might be to transfuse the sick short-loop dog from a long-loop dog, which may be supposed to have manufactured, in the course of his temporary illness occurring before the establishment of gastric drainage, certain antibodies which might be protective to the short-loop dogs. We have done a little work in transfusing the long-loop into the short-loop dog, and have noted improvement in the latter; but this might come from accumulation of the fresh blood rather than from the presence of anti-enzymes. We are, therefore, endeavoring to obtain a serum from the long-loop dog, with which we hope to tide the short-loop dog over his period of hypertoxicity, so that he too may live until the triangular control gives gastric drainage and assures permanent life.

REVIEWS.

MODERN MEDICINE. ITS THEORY AND PRACTICE. In Original Contributions by American and Foreign Authors. Edited by WILLIAM OSLER, M.D., Regius Professor of Medicine in Oxford University, England; Assisted by THOMAS McCRAE, M.D., Associate Professor of Medicine and Clinical Therapeutics in the Johns Hopkins University, Baltimore. In seven volumes. Volume V; pp. 903. Philadelphia and New York: Lea & Febiger, 1908.

VOLUME V of Osler's *Modern Medicine*, which is devoted to a discussion of the important subject of diseases of the alimentary tract, contains several notable contributions, particularly those on functional disorders of the stomach, by Julius Friedenwald; on organic diseases of the stomach, by Charles F. Martin; on diseases of the intestines, by Alfred Stengel; and on diseases of the peritoneum, by Humphry Davy Rolleston. The volume opens with a short introductory chapter by Charles G. Stockton on certain critical relations that may exist between disturbed physiological activity and structural changes. This comprises, among other matters, a discussion of the inter-relations and the adaptability and vicarious action of the digestive functions, the nature of the functional disturbances of digestion, the functional disturbances in relation to structural disease and structural changes resulting from functional disorders, infection in relation to digestion, disharmonies of secretion, the significance of the digestive juices and of the intestinal flora, and the influence of psychoneuroses on digestion—all of which, though briefly, is excellently told and serves well to introduce what follows.

Major interest centres in the description of diseases of the stomach. Dr. Friedenwald's seventy pages are all too few to allow of a thorough discussion of the protean manifestations of the so-called gastric neuroses, but what he says is eminently practical and to the point. Adopting Boas' classification of these neuroses into the monosymptomatic (comprising the irritative and the depressive group) and the polysymptomatic (nervous dyspepsia), he analyzes critically 1592 cases. C. F. Martin expresses the opinion that gastric ulcer has as its main etiological factors a destruction of the gastric epithelium, disturbance of the circulation in the stomach, and acidity of the gastric juice, the combination permitting autodigestion; but he seems not to have been able to adduce any conclusive evidence of the real cause of the necrosis, nor could any of us. As regards treatment, he prefers starvation or very little food for a time; he lays stress upon the necessity of care in the transition stages from a liquid

to a semisolid diet; and he says that examination of the feces for occult blood is an excellent guide for the transition to more generous diets. He regards surgical treatment indicated in chronic gastric ulcer that resists medical treatment for two months, in those cases that cause mild dyspeptic symptoms for a prolonged period and then culminate in hematemesis, and in chronic recurring ulcers even when each attack lasts only a comparatively short time. Unfortunately Dr. Martin has been unable to add much that will aid us in the early diagnosis of carcinoma of the stomach; but at present this may be said to be inherent in the nature of the disorder. In case reasonable suspicion of the disease exists, he advised exploratory operation to make, not to confirm, the diagnosis. The entire chapter of 152 pages on the organic diseases of the stomach is quite worthy of its author.

Dr. Stengel's chapter of 168 pages is an excellent summary of existing knowledge on the diseases of the intestine, tempered by the personal experience of the author. The introductory statements on physiological subjects are opportune and may be read with interest and profit. The diarrhoeic disorders are well described, and so also is constipation, although perhaps it would not have been amiss to have discussed in some detail the spastic constipation of some writers. The thirty-two pages devoted to appendicitis will repay the reading. The lesions are well described, although they are assumed to begin practically always in the mucosa—an opinion subject to modification in view of some recent work on the hematogenic source of the infection in some cases; the symptomatology and diagnosis are accurately portrayed; and as regards the treatment, it is said that, eliminating certain exceptional cases, the only proper treatment of acute appendicitis consists of immediate or prompt operation. But the exceptional cases include some that "will be regarded by both the physician and the surgeon as proper cases for non-operative treatment;" and here's the rub. Many of Dr. Stengel's brethren would have welcomed his own explicit opinion regarding the exact nature of these cases, as well as definite statements concerning the indications for operation from the point of view of the physician.

Humphry Davy Rolleston's 104 pages on diseases of the peritoneum are such as one naturally expects of their distinguished author. His discussion of the causes, nature, and types of ascites and of the acute and chronic forms of peritonitis are fully abreast of advanced knowledge, and faithfully reflect all that is really known of the subjects.

The aforementioned contributions on diseases of the stomach, intestines, and peritoneum comprise more than one-half of the volume; but there are other valuable although shorter communications. David Riesman contributes a chapter on diseases of the mouth and salivary glands. Attention is directed to the importance of septic

infection of oral origin and to the often overlooked fact that disease of distant organs (ulcerative endocarditis, pernicious anemia, etc.) may originate in bacterial infection of the mouth. The common forms of stomatitis are well described, as well as the changes in the mouth due to general diseases, such as typhoid fever, uremia, diabetes, pyorrhœa alveolaris, etc. The chapter is embellished by five excellent colored plates. John McCrae contributes a short chapter on diseases of the œsophagus, giving due emphasis, among other matters, to the importance of radiography with bismuth pastes in the diagnosis of diverticula and dilatation. Thomas R. Brown contributes 22 pages on splanchnoptosis (Glenard's disease), in which he accentuates the importance of a definite congenital defect as the underlying cause of the disorder in many cases, minimizes the significance of nephroptosis *per se*, and states that in the vast majority of cases the disorder is strictly medical and surgical only when the symptoms are so definitely referable to one or two organs that their suspension offers a good chance of the disappearance of the symptoms. Eugene L. Opie contributes a chapter of 62 pages on diseases of the pancreas, which is a reflection of the well grounded views of a pioneer worker in the subject. Emphasis is placed upon the significance and importance of changes in the islands of Langerhans in diabetes; but the absence of some discussion of the diagnostic significance of the Cammidge reaction in disease of the pancreas is noteworthy and somewhat to be deplored. A. O. J. Kelly contributes the concluding chapter of 174 pages on diseases of the liver, gall-bladder, and biliary ducts. One may perhaps venture the opinion that the less said about it the better. A. K.

THE SURGERY OF THE UPPER ABDOMEN. By JOHN B. DEAVER, M.D., Surgeon-in-chief to the German Hospital, Philadelphia, and ASTLEY PASTON COOPER ASHHURST, M.D., Surgeon to the Out-patient Department of the Episcopal Hospital, Philadelphia. In Two Volumes. Volume I, Surgery of the Stomach and Duodenum. Pp. 468; 76 illustrations. Philadelphia: P. Blakiston's Son & Co., 1909.

THE region of the upper abdomen presents problems for diagnosis and treatment of the greatest interest to the practitioner and the surgeon, more so perhaps than any other region of the body, because here reside the organs essential to digestion. Any disturbance of their anatomical relations, any disease causing perversion of their physiological functions, reacts upon the organism as a whole and profoundly affects the metabolism of the body. It seems fitting,

therefore, that a special treatise should be written upon the stomach, duodenum, liver and bile passages, pancreas, and spleen, if it presents the affections to which these organs are subject in a modern and scientific manner. The volume before us comprises the surgical lesions of the stomach and duodenum described by two surgeons who combine an experience and operative dexterity of the highest order with the ability to sift the writings of others with excellent judgment. The book contains 15 chapters, describing the anatomy, physiology, benign and malignant affections, operative technique, and incidental complications of the diseases in question.

The chapters upon the anatomy are excellent; anatomical matters are discussed as a whole, instead of the surgery of each organ being prefaced by a brief anatomical outline with its attendant repetitions. The physiology of digestion is well worked out and presents a good digest of the writings of Pawlow, Starling, Kelling, Cannon, and others. In discussing the etiology of gastric ulcer the authors believe that the continued study of normal physiology, together with the "living pathology" observed at the operating table, will probably determine, in the near future, the factors concerned in the production of this disease. We venture to assert, however, that progress in this direction is much more likely to be made in the experimental laboratory than in the clinical amphitheater. The entire subject of gastric ulcer is discussed broadly and thoroughly; in vigorous terms the attention of the medical man, who has cases of chronic gastric indigestion under his care, is called to the advantages of modern surgical treatment. It is unfortunate that Patterson's statistics are made use of, because, while he found less than 7 per cent. of 116 patients whose condition was unsatisfactory after operation, he was only able to trace 116 out of 247 patients to whom he sent inquiries; who knows the condition of the other 131 patients? Some attention might have been paid to the postoperative treatment of the ulcer cases, as but few observers will agree with the quotation from Kocher (p. 107) that "the patient does not require to pay any further attention to the nature of his food." All of the benign affections of the stomach are discussed in an able and interesting manner, including pylorospasm, dilatation, gastropptosis, hour-glass contraction, infantile stenosis of the pylorus, etc. Gastrojejunostomy is preferred to gastropexy in the treatment of gastropptosis, and the purely functional origin of pylorospasm is denied.

The difficult but important subject of gastric carcinoma is considered in 32 pages, and while nothing is offered to contradict our impression that in spite of an array of statistics this is a nearly hopeless disease from the standpoint of treatment, yet the topic is made interesting by the authors. The usual emphasis is laid upon chronic dyspepsia as the chief predisposing cause of gastric carcinoma and upon the fact that under medical treatment all patients will die in about twelve months unless the skilful surgeon steps in and

saves many lives otherwise doomed to destruction. It is gratifying to note the reduction in the primary mortality after gastrectomy, and that about 10 to 15 per cent. of patients treated by gastrectomy are said to be permanently cured. While it is true that excision following a diagnosis made in the incipient stage, or during the time, according to Menetrier's fanciful theory (p. 271), when an ulcer is progressing to the adenomatous stage, would in all probability always result in a cure, yet the ability to make such a diagnosis does not seem at present to be possible. The human race will immortalize the man whose research shows the exact method of cancer dissemination or who can devise a test whereby the tissue juices or blood will indicate that carcinomatous transformation is taking place.

The chapters upon the technique of operation and upon the complications and sequels are excellent, the index is sufficiently comprehensive, and an index of names adds to the usefulness of the volume. The authors are to be congratulated upon having produced a monograph furnishing accurate information upon every subject connected with the stomach and duodenum that may be amenable to surgical treatment. One cannot refrain from commenting upon the pedantic method of spelling *develope*, *clinique*, *elabourate*, etc.

G. P. M.

GYNECOLOGY AND ABDOMINAL SURGERY. Edited by HOWARD A. KELLY, M.D., F.R.C.S., Professor of Gynecologic Surgery in the Johns Hopkins University, Baltimore, and CHARLES P. NOBLE, M.D., S.D., Clinical Professor of Gynecology in the Woman's Medical College, Philadelphia. Volume II. Pp. 862; 871 Illustrations. Philadelphia and London: W. B. Saunders Co., 1908.

We had the pleasure of reading the first part of this work for review, and took occasion at that time to congratulate the authors upon the splendid contribution to medical literature which it represents. We are, if possible, more enthusiastic in regard to this, the second portion of the work. As is at once apparent, upon even a cursory examination, the present volume is true to its title and does not limit itself to the field of pelvic surgery. The editors advocate strongly that all men who open the abdomen shall be equipped to perform any operation demanded by the conditions present. There can be no possible criticism of their position, since no man can tell with certainty how many or what variety of complications may be met within the abdomen, and, therefore, no one can be considered a safe operator who is unable to cope with any condition possibly existent between the diaphragm and the pelvic floor.

The volume opens with a chapter of 78 pages by G. Brown Miller

upon the complications following operations, in which every possible condition is mentioned and those of importance carefully considered. The author has omitted to mention, in the prophylaxis of phlebitis, the new and radical practice of getting patients out of bed one or two days after subjection to major surgery; upon this omission he is to be congratulated. The chapter upon the Cesarean operation, contributed by J. F. W. Ross, is hardly a satisfactory exposition in the light of present-day experience. His statement that "Those who have performed Cesarean section will be most reluctant to consent to the induction of premature labor" must be adversely criticised. How many of us in our own family would consent to the abdominal delivery, if premature labor, two or at the most three weeks before term, gave good promise of a living child? We must certainly differ as to the advisability of ever instituting drainage in a clean case. Certainly most operators have now given up the use of the elastic cervical temporary ligature. It is most decidedly an exaggeration to say that an incision through the placenta, in incising the uterus, brings the operator "face to face with all the features of placenta prævia;" it would be fortunate, indeed, if the latter condition were as easily controlled as the former slight complication. The method of closure of the uterine wound advocated by the author is incomplete in that the use of a double-tier suture of buried catgut in the myometrium is omitted. Finally, the reversion to the old practice of abdominal binders "for some months after operative recovery" is not impressive.

Richard C. Norris, in a chapter of ten pages, considers the important subject of the operative procedures which may be required during the course of pregnancy for accidental complications. In his consideration of appendectomy he quotes Hirst's advocacy of the Cesarean operation after the seventh month of pregnancy, because of the difficulty of returning so large a uterus to the abdominal cavity. The operative treatment of sepsis in the child-bearing period, contributed by B. C. Hirst, is a concise statement of the opinions of the author. His recommendation in favor of instrumental exploration and evacuation of the uterus will be questioned by some good authorities, probably because the abuse of the method is too often mistaken for its proper use.

J. Whitridge Williams contributes a most scientific exposition of extra-uterine pregnancy. At the end of the chapter of over forty pages he has added a very complete bibliography. We are glad to note that the menstrual history is given second place in the symptomatology of the condition. His opinion that, so far, no single case has ever been reported affording indisputable proof of the occurrence of primary abdominal pregnancy, will meet with disapproval upon the part of some capable men. The chapter upon the diseases of the female breast, by J. C. Bloodgood, is one of the most noteworthy in the whole work. It is based upon a clinical and pathological study

of 1048 specimens obtained for the most part from the clinic of Professor Halsted; it comprises almost one hundred pages, is well and profusely illustrated, and is most painstaking in its attention to the minutiae of the subject. The definiteness of statement regarding the duties of the physician as well as of the surgeon is very timely. Albert J. Ochsner, in his consideration of operations upon the gall-bladder, bile ducts, and liver, leaves nothing to be desired, and the same is true of the next succeeding portion of the work upon operations upon the stomach, by B. G. A. Moynihan.

John B. Murphy, in a chapter of over 120 pages, gives a complete consideration of the subject of intestinal surgery. Our only criticism is that the incorporation of a detailed description of the various illustrations of intestinal suture would have been better than depending upon illustrations alone to convey the needful teaching. The chapters on operations for diseases of the vermiform appendix, by Howard A. Kelly and Elizabeth Hurdon, surgery of the pancreas, by Eugene L. Opie, and operations upon the spleen, by Howard A. Kelly, are impressive of the pregnant possibilities of the next decade.

With the space at our command it is manifestly impossible to present an adequate review of this work. All that we can hope to have accomplished is that by commenting upon certain features and by suggesting the scope of the subjects we may have given to the reader an intelligent idea of the extent of the work. From the time of our first knowledge that this book was in preparation, we have waited with impatience for its completion. There can be no question that it will have as favorable a reception as its great merits warrant.

W. R. N.

THE PRINCIPLES AND PRACTICE OF GYNECOLOGY. By E. C. DUDLEY, A.M., M.D., Professor of Gynecology in the Northwestern University Medical School, Chicago. Fifth edition; pp. 806; 431 illustrations and 20 full-page plates. Philadelphia and New York: Lea & Febiger, 1908.

THE work before us, in its fifth edition, can hardly be said to need a review, as the profession has definitely decided as to its merits by enabling the publication of the several editions. It is needless to say that the subject of gynecology has received adequate treatment. The author has made two additions in the present volume: one an introductory chapter and the other a chapter upon incontinence of urine in women. The first of these is one which we wish read by all gynecologists, as a means of encouragement to the further prosecution of their work, and by all general surgeons as an antidote to presumption. The author justifies the existence and perpetuation

of gynecology both by history and prophecy. The other chapter consists of but three pages, and is introduced to explain an operation for the advancement of the external urethra as a means of cure in conditions of incontinence of a non-inflammatory nature. His method consists in an inverted U-shaped denudation of the vestibule, with closure by catgut sutures. If efficacious it will certainly be a most important addition to the means of treatment of this very obstinate condition. Otherwise, with certain minor changes, and a considerable amount of revision, the book is unchanged. In our opinion it is one of the most satisfactory expositions of the subject of which we have knowledge.

There are of course some points upon which men of experience differ from the views set forth by the author; as, for instance, in his chapter upon cystoscopy it seems to us a pity that the Casper and Nitze models should be the only ones figured. We simply make this statement as an example of the only variety of criticism to which this book lends itself. In other words, any adverse criticism would simply be the exploitation of the personal opinions of the writer, and, therefore, according to our conception of the proprieties of review, has no place. We would call especial attention to the chapters upon the repair of perineal lacerations, because of the excellence of the illustrations as well as the letter press, and we are glad to note that the author is not an advocate of the immediate repair of lacerations of the cervix, or even their repair within a few weeks of the delivery. He believes that better results are to be obtained by operating some three months later. We are also very glad to find that his opinion of ventrosuspension has not been changed by the present fashion of performing all such operations through the medium of the round ligaments. His attitude is that, while fixation is wrong in the reproductive period, the operation which has for its aim the suspension of the uterus to the anterior abdominal wall by an artificially formed ligament, should not yet be cast away. He states that hysterorrhaphy properly performed gives more security against recurrence of displacement than any of the ligament-shortening operations. He nevertheless gives a full account of the Alexander and Gilliam operations, with a modification of the latter which seems to us to promise well. He prefers the last-mentioned method in his own work, except in selected cases, in which he still does the suspension from the abdominal wall.

Any attempt further to indicate the subjects discussed would simply result in the incorporation of the table of contents; suffice it to say, that the whole subject of gynecology is carefully covered, but that the author stops there and does not treat of conditions of the upper abdomen. In this we believe him to be wise, since, although the upper abdomen is properly within the province of the gynecological operator, there is a distinct benefit in the limitation of text-books to the old lines.

W. R. N.

GENERAL SURGERY. A PRESENTATION OF THE SCIENTIFIC PRINCIPLES UPON WHICH THE PRACTICE OF MODERN SURGERY IS BASED. By EHRRICH LEXER, M.D., Professor of Surgery in the University of Königsberg. American edition, edited by ARTHUR DEAN BEVAN, M.D., Professor and Head of the Department of Surgery in the Rush Medical College in Affiliation with the University of Chicago. An authorized translation of the second German edition by DEAN LEWIS, M.D., Assistant Professor of Surgery in the Rush Medical College in Affiliation with the University of Chicago. Pp. 1041; 449 illustrations and 2 plates. New York and London: D. Appleton & Co., 1908.

THIS translation of a successful German text-book on surgery will be cordially welcomed by the profession in this country. Prof. Lexer is well known here, particularly for his remarkable achievements in the surgery of the bones and joints, and it will be a pleasure to those who do not read German with facility to become acquainted, through Dr. Lewis's admirable translation, with the views and the teachings of one of the foremost of continental writers.

The volume, which deals solely with general surgery, is divided into seven parts, as follows: Part I, which includes: (1) Wounds, their treatment and repair; (2) aseptic technique; (3) general and local anesthesia; (4) general principles of plastic operations. Part II. Wound infections and surgical infectious diseases: (1) The nature of infection, local and general reaction; (2) wound infections caused by pyogenic and putrefactive bacteria and their results; (3) wound infections of different origins and surgical infectious diseases. Part III. Necrosis. Part IV. Injuries of soft tissues, bones, and joints, and their treatment: (1) Mechanical injuries; (2) chemical injuries; (3) thermal injuries; (4) general results of injuries. Part V. Important surgical diseases, excluding infections and tumors: Diseases of the skin, etc., muscles, tendons, bloodvessels, nerves, joints, and bones. Part VI. Tumors. Part VII. Cysts. There are also two appendices to the American edition: the first, on direct transfusion of blood, is an abstract of Crile's work; while the second, on opsonins, phagocytosis, and therapeutic inoculations of dead bacteria, has been contributed by Dr. Rosenow.

When an English-speaking professor of surgery candidly admits that he can find no text-book in his own language to suit him, and, instead of supplying the deficiency by one of his own, deliberately adopts a German volume as the standard of instruction for his students, he in a measure challenges criticism of his judgment of American and English text-books in general, and of his selection of the particular volume now before us for review. No apology, we believe, is needed for Dr. Bevan's high appreciation of the value of a training in the principles of surgery before the study of the practice of this art is begun; but we certainly think it doubtful

whether cramming so much theoretical knowledge down the throats of medical students at one meal, as it were, without any accompanying jam in the nature of clinical application of the theories expounded will not rather produce a disgust for further study than an eagerness to learn more. In other words, we believe this volume contains an unnecessary amount of matter for the third-year student, for whose use it is designed; and that the rather unpalatable form in which the pabulum is served will tend to make the acquisition of a knowledge of surgical principles more difficult for the student, instead of easier, which should be the aim of every teacher. Particularly useless to the American student are the long lists of bibliographical references, almost exclusively to German literature, which have been transferred in bulk from the German edition. Even when rare references are made in the text to the work of an English, French, or American writer, it is the exception for the bibliography to contain his name. To such an extent is this Anglophobia carried that even the editor's own suggestions are expounded in German at p. 315.

A text-book on surgery may be criticised, first, as to inclusiveness and exclusiveness; second, as to arrangement of subject matter. There are included in this volume some topics which really belong to general medicine, and which seem decidedly out of place in a text-book on surgery. Mention may be made of diphtheria, to which ten pages are devoted, as an example of lack of exclusiveness. Blastomycosis is discussed by Dr. Oliver Ormsby at a length of seventeen pages; surely this is a disproportionate amount of space to devote to such a topic, when only eight pages are occupied by local reaction to infection (inflammation), and less than seven pages to open wounds of bloodvessels, including the treatment of hemorrhage. Should Prof. Lexer adopt Dr. Bevan's suggestion that this chapter on blastomycosis be included in the next German edition, it is to be hoped that he will curtail it to a reasonable length. Among subjects which are slightly described or not mentioned at all are to be noted: Linen as a suture material; general anesthesia by ethyl chloride; the Matas operations for aneurysm (dismissed in four lines of text, though illustrated by eleven figures); and traumatic asphyxia, which is mentioned, though no name is given the condition; moreover, no notice is taken of the recent use of bismuth injections in the treatment of sinuses; a description of the use of *x*-rays and of skiagraphic examination for diagnosis is nowhere to be found; and there is no reference to the subject of traumatic delirium, unless it be included in the term "torpid and erethistic shock," which seems rather to correspond to what English and American surgeons, following the classical nomenclature of Travers, have long described as "prostration with excitement." Some of these omissions are excusable in the German edition, which dates from 1906; but they might well have been added by the American editor.

But the arrangement of the volume affords the chief ground for criticism. Here students are taught the treatment of wounds as the first lesson in surgery, not only before antiseptis and asepsis are discussed, and before the subject of wound repair has been learned, but even before the study of the local reaction of the tissues to injury has been described. It thus happens that the discussion (beginning at p. 35) of repair of wounds by "first" and "second intention" is mere gibberish until p. 146 is reached, where the local reaction to infection is described; and the causes of infection (bacteria) are not taught until p. 169, not only after the lesions they produce have been discussed, but considerably more than 100 pages after the subjects of asepsis and antiseptis have been concluded. This is a *hysteron proteron* with a vengeance! How can students be expected to appreciate the value of aseptic technique until they have been taught the pathology of infection?

These criticisms apart, the volume presents the subject of surgery in a very satisfactory manner, and with a wealth of original illustration which it would be difficult to surpass. A. P. C. A.

SURGICAL APPLIED ANATOMY. By SIR FREDERICK TREVES (BART.), Consulting Surgeon to the London Hospital. Fifth edition; Revised by ARTHUR KEITH, M.D., Lecturer on and Senior Demonstrator of Anatomy at the London Hospital. Pp. 640; 107 illustrations. Philadelphia: Lea Brothers & Co., 1908.

THIS volume is little in size only, as by the use of thin paper and small print a great mass of facts is compressed between its covers. The book has so long served as a *vade mecum* for students and practitioners of medicine that comment upon its field of usefulness or criticism of its contents would merely indicate a desire to try to find minor faults and differences in opinion inherent to any book. In the present edition the work has been revised and brought up to date, and the illustrations have been improved. The chapters upon the extremities are the best in the book, perhaps because in similar works the head and abdomen receive so much more attention. There are omissions from the anatomical standpoint, and some of the methods of procedure are clumsy, but the book succeeds in presenting the subject in a vivid, interesting, and sufficiently exact manner to make it most valuable as an introduction to the study of surgery, and as a guide to an intelligent and proper understanding, by the student, of the various surgical methods while he is engaged in ward duty. G. P. M.

PROGRESS OF MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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The Early Diagnosis of Pulmonary Tuberculosis.—HAUSMANN (*Deut. Arch. f. klin. Med.*, 1908, xciv, 595) was struck by the number of gastric cases in his practice which presented evidence of apical lesions. Those who raised no sputum he often sent to a lung specialist, and frequently his diagnosis of incipient pulmonary tuberculosis was reversed. Feeling that he was correct, he decided to examine the fasting stomach early in the morning for small particles of bronchial secretion. His first patient gave no history of cough, but had definite signs in one apex, his chief complaints being a feeling of fulness and weight in the epigastrium. A very small particle of mucus enclosing pus cells and lymphocytes and a few alveolar epithelial cells was obtained from the stomach, and when stained showed about ten tubercle bacilli in a field. In the last two months he has had six similar cases, all with the same result. He urges the usefulness of his method and suggests that some of the so-called "closed" or "healed" cases may be shown by this means to be in reality "open" cases of tuberculosis.

A New Clinical Test of Pancreatic Function.—E. ENRIQUEZ, L. AMBARD, and M. BINET (*Semaine méd.*, 1909, xxix, 13), note the importance of a knowledge of the function of the pancreas which may be gained by an estimation of the ferments lipase, trypsin, and amyllopsin, especially if these can be regained totally from the stool. It is very difficult to do this with the first two, but the quantity of amyllopsin can easily be determined. Previous work has shown that amyllopsin is more abundant in diarrhoeic stools. The authors in their research

on 150 subjects have evolved the following technique to obtain the maximum amount of amylopsin. To prevent the destruction of the ferment by trypsin, the person is first given some milk, about three-quarters of a liter, as the mixture of trypsin with the albumin will prevent its destructive action on the other ferments. A piece of ice is also placed in the vessel that receives the dejecta, to restrain microbic action. The unit used for expressing is the amount of sugar that can be formed in one hour by the total amount of the ferment (that is, sugar-gram-hour unit). The stool being diluted with water (20 liters), 1 c.c. of this mixture is added to 50 c.c. of a 1 per cent. solution of starch, acidified with HCl, and the whole incubated at 39° C. for half an hour. The amount of sugar produced is then determined quantitatively for this amount and so calculated for the total feces, the figures resulting giving so many amylopsin units. The amount of these units is fairly constant in healthy persons, but in two cases of carcinoma there was almost complete absence of amylopsin. The authors feel that further work along these lines and a more perfected technique will aid in understanding the function of the pancreas.

The Relation of Tetany to the Parathyroid Glands and to Calcium Metabolism.—W. G. MACCALLUM and C. VOEGTLIN (*Jour. Exp. Med.*, 1909, xi, 118) report the experimental work on this subject which they have been carrying on for some time, and conclude that there is an intimate relation between the various forms of tetany and the relative or absolute insufficiency of the parathyroid gland. These glands have a definite specific function. When extirpation of the parathyroids is complete, tetany appears, even in herbivora. Only a small amount of parathyroid tissue is required to prevent this. The effect of extirpation may be annulled by the re-injection of an extract of these glands, even from an animal of a widely different character. The parathyroid glands contain no considerable amount of iodine. In tetany there is apparently some disturbance of the composition of the circulating fluids, ordinarily prevented by the normal secretion of the parathyroid; this change in the composition disarranges the balance of the mineral constituents of the tissues. Calcium salts bear an important relation to the excitability of the central nervous system; their withdrawal leaves the nerve cells in a state of hyperexcitability, which can be made to disappear by supplying them with a solution of a calcium salt. Tetany may be regarded as an expression of hyperexcitability of the nerve cells from some such cause; the injection of a solution of a salt of calcium into the circulation of an animal in tetany promptly checks all symptoms and restores the animal to an apparently normal condition. Sodium and potassium, as well as some other salts that have been studied, have no such beneficial effects. This effect of calcium is of value in human therapeutics as a means of tiding over the period of acute parathyroid insufficiency until remnants of parathyroid tissue can recover their function or new parathyroid tissue be transplanted. The metabolism in parathyroidectomized animals shows among other things a marked reduction in the calcium content of the tissues, especially of the blood and brain during tetany, and an increased output of calcium in the urine and feces on the development of tetany.

In general, then, the role of the calcium salts in connection with tetany may be conceived of as follows: These salts have a moderating influence upon the nerve cells; the parathyroid secretion in some way controls the calcium exchanges in the body. It may possibly be that in the absence of the parathyroid secretion substances arise which can combine with calcium, abstract it from the tissues, and cause its excretion, and that the parathyroid secretion prevents the appearance of such bodies. The mechanism of the parathyroid action is not determined, but the result, the impoverishment of the tissues with respect to calcium and the consequent development of hyperexcitability of the nerve cells and tetany, is proved. Only the restoration of calcium to the tissues can prevent this.

The Antitryptic Power of the Serum of Diagnostic Value.—L. AMBARD (*Semaine méd.*, 1908, xxviii, 532) notes that it has been known for some time that serum possesses the property of inhibiting the action of trypsin, thus checking the digestive power of the pancreatic juice. At one time this power was supposed to be of definite value in the diagnosis of cases of cancer, but later it has been found in other conditions. In animals this antitryptic power is increased by the injection of trypsin, and in man by the ingestion of pancreatin. This increased power and its compensatory hypersecretion forms a common link between cancer, nephritis, etc., and other conditions in which the antitryptic power of the serum is increased.

An Epidemic of Disease due to the Mouse Typhoid Bacillus.—FLEISCHANDERL (*Münch. med. Woch.*, 1909, lvi, 392) reports an epidemic of 20 cases occurring in his practice in April, 1908. The disease was characterized by a rapid onset with abdominal pain, followed in the next few hours by diarrhoea (eight to twenty stools in twenty-four hours), fever, and general malaise; the symptoms increased for two to three days, the temperature reaching 39° to 40° C.; in one case, vomiting, sharp abdominal pains, giddiness and staggering on walking occurred, and there was marked prostration; later, a rapid subsidence of symptoms and great lassitude for several days. In one case the convalescence was protracted through two weeks. The mild cases were without fever and all the symptoms were less severe. Fleischanderl thought of a paratyphoid epidemic, but, on inquiry found that Loeffler's mouse typhoid bacillus was being used in the locality to exterminate the field mice. His patients had aided in scattering bread which had been soaked in a suspension of mouse typhoid bacilli on the day preceding the onset of their illness. They had not washed their hands before eating, and thus there was every chance for infection. In the family of a teacher the father, mother, and one son were attacked, another son being unaffected. Inquiry developed the fact that all three had drunk milk from a pail which had previously contained bread and mouse typhoid bacilli suspension on the day before onset. The son who remained well had drunk no milk and had not distributed infected bread. The circumstantial evidence against the mouse typhoid bacillus was strong. Fleischanderl now infected himself by way of the alimentary tract. He was in perfect health, never had suffered from intestinal disorders, and had had no typhoid fever in his practice for over a year. Twenty-

two hours after infection he was attacked with mild abdominal pain, which soon became severe. Temperature and pulse remained normal. Three hours later diarrhoea began, and eight hours later he had a slight chill. His temperature rose to 38.7°C .; pulse, 106. He now had severe abdominal pain and prostration. At the end of thirty-six hours the temperature had risen to 39.2° , the pulse to 120. These symptoms lasted for forty-eight hours and then rapidly subsided, but left the patient in a depressed condition for two days longer. From his own feces as well as from those of some of the patients the bacillus of mouse typhoid was recovered in pure culture and proved by re-infection of mice. Serum from rabbits immunized to a laboratory culture of the mouse typhoid bacillus agglutinated not only the original culture, but also the various cultures obtained from the stools as well as the culture Fleischanderl used to infect himself. The agglutination was obtained in dilutions varying from 1 to 20 to 1 to 320. No agglutination occurred in controls or with the paratyphoid bacillus.

The Relation of Bovine to Human Tuberculosis.—W. L. Moss (*Johns. Hopkins Hospital Bulletin*, 1909, xx, 39) summarizes the literature on this important subject, and concludes that, while the circumstantial evidence points more or less strongly to the conception that human beings may be infected with tuberculosis from bovine sources, yet absolute proof is wanting. But the evidence that tuberculous cattle are a source of danger to man is so strong that on the basis of this alone it would seem advisable to take strict precautions against bovine tuberculosis. The economic losses among the cattle themselves, aside from any danger to man, are sufficiently great to demand a vigorous effort to stamp out bovine tuberculosis. The evidence furnished by autopsy statistics of primary intestinal tuberculosis reported by different observers is very complicated, and even if there was an agreement on its high incidence, this evidence could only be taken as circumstantial, since there is abundant opportunity for primary intestinal infection to occur with tuberculous material of human origin. The use of tuberculin from human and from bovine bacilli has not yet thrown much light on the question. The agglutination reaction does not seem to differentiate the two types of bacilli. It seems definitely established that there are two distinct types of tubercle bacilli, the human and the bovine, and that mutation from one type into another does not occur. The bovine type of bacillus has been demonstrated in 20 per cent. of the series of 306 cases among human beings. The bacillus which causes bovine tuberculosis may also cause tuberculosis in man, but infection need not be received directly from cattle, for it is easily conceivable that a human being having become infected from cattle may pass the infection on to other human beings. The dangers from bovine tuberculosis to man are sufficiently great to warrant strict precautions against it.

Infusoria in the Stomach.—COHNHEIM (*Deut. med. Woch.*, 1909, xxxv, 92) refers again to the occurrence of infusoria in the stomach and œsophagus and reports seven new cases. The parasites live only in the absence of free hydrochloric acid, and thus far they have been found in the great majority of cases in patients with carcinoma of the stomach or œsophagus. They are most often found in the mucus or the muco-

purulent material. Trichomonads are most frequently present (megastoma has been found occasionally). Cohnheim has looked for the parasites in many cases of achylia gastrica which were not carcinomatous, and found them in only one case. In achylia associated with cancer in parts of the body other than the stomach he has failed to demonstrate the organisms. Of the cancer cases it is especially those that are ulcerative that are apt to show infusoria. Cohnheim does not believe the infusoria, especially the trichomonads, cause an enteritis. In all cases in which he has found them in the feces he believes they have been secondary to gastric disease.

Fat-splitting Ferment in the Lymphocytes.—BERGEL (*Münch. med. Woch.*, 1909, lvi, 64) has studied the ferments of the lymphocytes, especially with reference to fat-splitting ferment. The lymphocytes were obtained from (1) tuberculous pus; (2) the exudate resulting from subcutaneous injection of 1 to 2 c.c. of old tuberculin in guinea-pigs; (3) the spleen; and (4) lymph glands. He tried various substances, but found that plates of yellow wax and of neutral butter fat were the most satisfactory. On the yellow wax plates these substances containing lymphocytes caused crater-like depressions after being placed in an incubator at 52° for twenty-four hours. As controls, physiological salt solution, rabbit's serum, red blood cells suspension, tuberculin, lecithin, fibrin, amylum, and trypsin were used and produced no cupping. Human blood containing both lymphocytes and fat splitting ferment caused a slight depression on the surface of the wax. In a case of "mixed-celled leukemia, lymphocytes predominating," a well-marked cupping resulted. Tuberculous pus usually produced the greatest depressions. Neutral butter fat was rendered acid by the same substances, the control remaining neutral.

The Differential Diagnosis of Acute Leukemias.—SCHULTZE (*Münch. med. Woch.*, 1909, lvi, 167) refers to the difficulty that exists in differentiating acute lymphoid and myeloid leukemias. In the chronic cases the differential diagnosis is easy, but acute cases are quite the reverse, for here one has to differentiate the lymphoblast, the antecedent of the lymphocytes, from the myeloblast, which is the parent cell of the granular leukocytes. The two cells are practically identical in size, each possesses strongly basophilic protoplasm, and their nuclei are similar. Schridde describes a narrow clear border about the nucleus of the lymphoblast, but for most observers this is not a practical differential point. Schultze makes use of the so-called oxydase reaction (indophenol-synthese) for differentiating these cells and especially for differentiating the tissues of lymphoid from those of myeloid leukemia. For carrying out this reaction a 1 per cent. aqueous solution of α -naphthol and 1 per cent. aqueous solution of dimethylparaphenyldiamin (E. Merck) are needed. The naphthol, which is only slightly soluble, is warmed and then filtered after cooling. The two solutions when united form a blue color under the action of light through an oxidative synthesis. In the presence of an oxidative ferment the process is greatly accelerated. Myeloid tissue when treated with these solutions is stained blue, owing to the presence of an oxidative ferment, while lymphoid tissue remains unstained. The method is especially applicable to tissue.

Pneumococcic Influenza.—CURSCHMANN (*Münch. med. Woch.*, 1909, lvi, 377) reports a series of cases admitted to his clinic in Leipzig during the fall, winter, and spring of 1907 and 1908 which were clinically typical cases of influenza. In 49 of these patients careful bacteriological studies were made of the sputum, and in none of them was Pfeiffer's bacillus found, although it had been practically constant in previous epidemics. In 46 of the cases there was found the Fraenkel-Weichselbaum diplococcus, which was characteristic in all respects, that is, capsule formation, extracellular occurrence, reaction to dyes, culture media, etc. In a large number of the cases this organism was present in the sputum in almost pure culture. In the remainder it was constantly found to be the predominating organism, so that there can be scarcely any doubt as to its etiological importance. In 20 cases mice were inoculated, with the characteristic results and autopsy findings. Curschmann feels justified in saying that the epidemic in Leipzig which was influenza clinically was due not to *Bacillus influenzae*, but to Fraenkel's diplococcus. This finding in no way changes the status of the Pfeiffer bacillus, which wrought such havoc during the pandemic of 1889 to 1893.

SURGERY.

UNDER THE CHARGE OF

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The Surgical Treatment of Cancer of the Mouth.—STEINER (*Deut. Zeit. f. Chir.*, 1909, xcviii, 1) reports a study of 132 cancers of the mouth, including the tongue. These cancers rapidly extend locally and involve the neighboring lymph glands, because of the rich lymphatic supply. They may occur at any age from the second decade on: 57 per cent. of the 61 cancers of the cheek developed between the ages of forty-one and fifty-five years; 60 per cent. of the 51 cancers of the tongue and sublingual region between forty and sixty years; 3 per cent. of the whole 132 cases occurred in females. Congenital anomalies, scars, psoriasis, and leukoplakia, in many cases, preceded the cancerous formation. The free use of tobacco, by smoking and chewing, favors the development of cancer. Metastasis was shown in the neighboring lymph glands in the earliest stages of the growth. More remote metastasis is rare. The operation in every case should consist in the removal of the primary growth and the cleaning out by dissection of the cervical region on both sides. The operative mortality of cancer of the mouth was 24.1 per cent. It was least (4.5 per cent.) in cancers of the cheek, and greatest in those of the tongue. A radical cure, that is, with no

recurrence for more than three years, was obtained in 10.3 per cent. of the cases.

The Surgical Treatment of Cancer of the Breast.—STEINER (*Deut. Zeit. f. Chir.*, 1909, xcvi, 21) studied 170 cases of cancer of the breast. It is most frequent between the ages of forty and sixty years. Pre-disposing causes are heredity (3 per cent.), chronic inflammation (6.6 per cent.), trauma (17 per cent.), congenital anomalies, and Paget's disease. 2.6 per cent. of the cases occurred in the male breast. One mammary gland is no more disposed to become cancerous than the other. In half of the cases operated on by the Heidenhain method, the cancer had existed more than a year. The axillary glands were invaded in 65 per cent. of these, and in 35 per cent. the cancer was ulcerating. Ten per cent. of the primary cancers operated on by this method were free of recurrence more than five years after operation. In 53 of the 72 cases operated on by the more complete Halsted-Kocher operation, the cancer had been present more than one year before operation. Regional involvement of the lymph glands existed in 74 per cent. of the cases, and ulceration of the growth in 17 per cent; 27 per cent. of the cases operated on for primary growths were free of recurrence more than one year after operation; 21 per cent. of the cases operated on for recurrent cancers, remained free of recurrence more than five years after operation. In half of the cases which recurred, death occurred in the first year after operation, and always within the critical three years.

Snapping Hip Joint.—ZUR VERTH (*Deut. Zeit. f. Chir.*, 1909, xcvi) says that voluntary snapping of the hip is due to the ability, through contraction of certain muscles and the exclusion of others, to cause part of the fibers of the iliotibial band of the fascia lata to pass quickly over the great trochanter. This ability is inborn in many people, while most others can learn it. No troublesome conditions are associated with the voluntary type of snapping hip. Accessory diseases, like bursitis, can, of course, produce pain. It is not an infirmity, but a trick. The habitual snapping of the hip is a pathological condition, dependent upon inflammation of the fascia lata and its associated bursæ or upon paralyses, lacerations, or other chronic inflammations of the fascia or a part of the gluteus maximus. This condition expresses itself by certain involuntary audible and palpable quick movements over the great trochanter. It is associated with acute pain, and requires, according to its cause, operative or functional treatment. The changes in the relation of the trochanter to the pelvis after luxation of the fascia, can be so considerable that a careful examination by the eyes and palpation and a skiagraph will be necessary in order that it may not be mistaken for a dislocation of the femur. The diagnosis of a luxation or a subluxation of the femur must depend upon the proof that the head is entirely or partly outside of the acetabulum.

Double Nephrectomy and Re-implantation of one Kidney.—CARREL (*Archiv f. klin. Chir.*, 1909, lxxxviii, 379) has shown that a kidney extirpated and then re-inserted in place is in a condition to functionate so that the animal affected may live more than eight months. The technique of the operation of transplantation is so well developed that

it involves little danger in itself. Only one of six animals operated on died as a result of the operation. The four other deaths were the result of complications, such as tuberculosis, ascending pyelitis, and hydro-nephrosis, all of which can be avoided. Usually the animal recovers very quickly after the operation and conducts itself as before. A serious vessel or kidney complication, therefore, does not exist. After some weeks, the cicatrix at the line of union in the vessel wall is linear and does not induce secondary abnormal conditions, such as aneurysm, hemorrhage, or stricture. It is worthy of note that a kidney whose circulation had been stopped for almost an hour, and which had been kept in Locke's solution, and its nerves severed, should, after re-implantation, functionate in a normal manner and after eight months show no signs of disease. According to Bindo de Vecchio, division of the kidney nerves, causes symptoms of disease of the epithelial cells. The classical, physiological view is that enervation of the kidney leads to disturbance in the secretion of the urine. The quantity is abundant, the specific gravity diminished, and it contains albumin and red blood cells. In a dog, Carrel removed the right kidney and brought out the left kidney, which was left attached to the rest of the body only by the bloodvessels and ureter, the latter being as freely exposed as possible. Five days later the animal urinated 130 c.c. in twenty-four hours. After one month, 90 to 124 c.c. of urine was voided daily. This urine was of moderate density and contained no albumin. More than a year after operation the animal was still living and in good health. Carrel concludes, from his series of experiments in kidney transplantation and re-implantation, that the technique of the operation is sufficiently perfected to permit the avoidance of immediate or late complications arising from the bloodvessels. The ability to withstand the operation, the temporary interruption of the circulation, the washing of the kidney, and the division of the nerves is demonstrated by the excellent functional results in the organ more than eight months after operation.

Infection of Gunshot Wounds.—VON REYHER (*Archiv f. klin. Chir.*, 1909, lxxxviii, 576) says that a primarily infected gunshot wound may contain infecting material from the gun barrel, or the ball, shreds or fibers of clothing, or portions of epithelium. He concluded that every gunshot wound in war is primarily infected. Of the wounds from shrapnel-filled shells, 62 per cent. were infected, and of the wounds from jacketed bullets, 20 per cent. were infected. This would show that in 38 per cent. of the one and in 80 per cent. of the other type of wounds the organism is capable of mastering the infection by means of its own bactericidal strength. The secondary infections play a subordinate role in war. Primary infection is encouraged only in large caliber wounds, and is almost always associated with extensive wounds of the soft tissues. The most severe infections are primary. The severity of the wound controls in a measure the severity of the infection. The chief dangers of wounds come from the pieces of clothing carried in. These pieces are larger from shrapnel wounds than from the jacketed bullets. The clothing of soldiers in the field is very infectious. The number of severe infections was highest in the hospitals nearest the field of battle. The number of infections and the death rate decreased the further the hospital was from the battlefield.

Primitive Cancer of the Right Ureter.—ZIRONI (*Ann. des mal. des org. gén.-urin.*, 1909, i, 81) reports a case of cancer of the right ureter in a woman, aged thirty-six years. The kidney was exposed by operation and found hydronephrotic. By digital examination in the dilated ureter a mass was recognized in its wall and two small pieces excised. The kidney was fixed to the abdominal wall in the wound and gauze drainage introduced. Death occurred on the ninth day after operation. At autopsy the right ureter was opened, and it showed at its upper end three nodules, close together, and lower down several others. In the lower third of the ureter was found a mass about the size of a guinea-hen's egg in the wall of the ureter, in the centre of which was found a calculus about the size of a hazelnut. Sections from the different neoplastic masses showed them to be cancers. Rokitsanski and others have shown that the pavement epithelium which lines the pelvis of the kidney and the whole ureter may, as the result of simple calculus or tuberculous inflammation, be transformed into several layers, while the mucosa becomes infiltrated with round cells and consequently sclerotic. This condition is called leukoplasia and is frequently found on the tongue, the inner surface of the lips, or the vulva, and in the vagina.

Regional Anesthesia for the Transplantation of Skin.—NYSTROM (*Zentr. f. Chir.*, 1909, xxxvi, 137) says that in most of the cases in which he employs the Thiersch or Krause method of skin grafting, he produces regional anesthesia on the outer surface of the thigh by anesthetizing the trunk of the external cutaneous nerve through the skin, and then taking the skin grafts from the anesthetized area. The skin of the greater part of the outer side of the thigh is supplied by this nerve. A 1 per cent. novocaine solution is preferred, in which every 10 c.c. contains five drops of a 1 to 1000 adrenalin solution; 4 to 5 c.c. of this mixture is injected just to the inner side of and below the anterior superior iliac spine, and at varying depths, a part at least under the fascia lata, but not too deeply into the muscles. After ten minutes, which may be employed in cleansing the granulating surface to be grafted, the analgesia will be complete. When such preparation of the granulating surface is not necessary, the transplantation may be entirely painless, aside from the pricking of the hypodermic needle.

The Sensibility of Abdominal Organs.—KAST¹ and MELTZER (*Mitt. a. den Grenzg. der Med. u. Chir.*, 1909, xc, 586), as the result of experimentation, reached the following conclusions: The abdominal organs in dogs, manipulated through a small opening in the abdominal wall, are evidently acutely painful. Inflammation increases markedly the pain in the abdominal organs of dogs. When all the intestines or a large part of them are drawn out or freely exposed, there is a marked decrease in sensation, which is the more marked the weaker the animal becomes. Simultaneously the animal becomes more apathetic and the sensitiveness of the skin is decreased. Laparotomy also depresses the motor activity of the gastro-intestinal canal. The motor and sensory depression depends upon a reflex inhibition which is central in origin and can extend to other centres. In weak animals and after a prolonged procedure the sensory inhibition extends to the vital centres in the medulla oblongata, and often leads to fatal shock. It appears also that

the peripheral mechanism in the intestinal canal is inhibited up to a certain point. The intestines of cats and small dogs also possess acutely sensitive nerves. They become exhausted easily, however, and by laparotomy are very quickly and strongly influenced. The nerves of the intestines suffer much more strongly and quickly than those of the mesentery. Surgical operations in men do not permit one to prove that the intestines in the normal closed body do not possess sensory fibers. Until more definite proof is offered that the sensory innervation of the human intestines differs radically from that of other mammals, it must be accepted that, as in animals so in men, the abdominal organs are supplied with their own sensory nerves, and that the sensitiveness of these organs can be increased by inflammation, as in animals. This hypothesis explains in a simple manner the well-known occurrence of all kinds of severe pain in the human abdomen.

Experimental Investigations Concerning the Heart and Trauma.—KÜLBS (*Mitt. a. den Grenzgeb. der Med. u. Chir.*, 1909, xc, 678) says that valvular disease of the heart can result from trauma, indirectly, through violence applied to the chest wall. Pure lacerations of the valves have been found in such cases at autopsy, also bloody infiltration of the valves. That such injured and changed valves may become the seat of infection has also been shown, and a similar condition has been produced experimentally. When no infection takes place in such cases, there may develop under certain circumstances a gradual valvular insufficiency. Külbs was able, with relatively mild, blunt force applied to the chest wall, to produce in animals, frequently, extensive heart injuries without any considerable damage to the skin or chest wall. These injuries consisted chiefly in hemorrhages, most frequently in hemorrhages of the valves. Hemorrhages of the heart muscle and of the pericardium were produced also. The valvular hemorrhages, apparently, were mostly absorbed. The muscle hemorrhages were replaced by connective tissue. Judging from the frequent extensive hemorrhages at the bases of the valves extending deeply into the muscle substance, it is concluded that they do not heal without defects. In those cases in which gross anatomical defects were found postmortem, Külbs had not been able to detect previously, by auscultation or by the pulse, signs of cardiac insufficiency. In the causation of these lesions the yielding nature of the chest wall played an important part, as was shown by the varying experiments.

The Intra-abdominal Administration of Oxygen.—BAINBRIDGE (*Annals of Surgery*, 1909, xlix, 305) had reported in a previous paper that he had employed oxygen by inhalation; by infusion into the pleural cavity; by injection into abscess cavities, carbuncles, furuncles, and other inflammations, acute and chronic; by injection into tuberculous joints; by infusion into the abdominal cavity, allowing the gas to be absorbed—in the following conditions: tuberculous peritonitis, with ascites; after removal of ascitic fluid from whatever cause; following severe laparotomies for the control of shock, for its influence upon hemorrhage, cyanosis, nausea, and vomiting, and for the prevention of adhesions. Since the publication of the paper referred to above, he has continued to test the utility of the intra-abdominal administration of oxygen whenever it seemed to be indicated. In this research the field of usefulness has

gradually enlarged. It is now administered to lessen shock, hemorrhage, nausea, and vomiting; to overcome negative intra-abdominal pressure after the removal of large tumors; to prevent the formation of adhesions; for its effect upon pus-producing organisms and their toxins. The gas is warmed, usually to a temperature of 90° to 100°, by passing it through a tube from the tank in which it is compressed into a wash bottle filled with hot water. This long exit tube is again connected with a piece of glass tubing, and to this, in turn, is attached a piece of sterile rubber tubing, through which the gas is introduced into the abdominal cavity. In this last piece of tubing, at the distal extremity, are two openings, one in the end which is cut obliquely, and the other in the wall of the tube near the end. When the gas is introduced the wound is first closed around the tube, and when the desired quantity is in the abdomen, a purse-string suture of the peritoneum is tied as the tube is carefully withdrawn. The abdomen is ballooned with the gas, which is gradually absorbed by the tissues. Bainbridge concludes from this study that oxygen, intra-abdominally administered, has a distinct field of usefulness in lessening shock, hemorrhage, nausea, and vomiting; in overcoming negative intra-abdominal pressure after the removal of large tumors; in preventing the formation of adhesions, or, when broken up, lessening the liability of their return; and in influencing favorably certain types of tuberculous peritonitis. In three cases, in which the gas was introduced into the peritoneal cavity in septic peritonitis, sufficient beneficial effect was noted to warrant the hope that further clinical experience may establish the efficacy of the gas as an adjuvant in the treatment of this condition.

The Value of the Leukocyte and Differential Counts in Appendicitis.—

PEASE (*Annals of Surgery*, 1909, xlix, 385) reports a study of 300 appendicitis cases treated in the Presbyterian Hospital of New York, in which leukocyte and differential counts had been made previous to, and the pathological lesions demonstrated at, operation. The more severe the pathological lesion the higher the leukocyte count and the higher the percentage of polymorphonuclear cells in the differential count. A good many of the cases of general peritonitis, however, gave a low leukocyte count, and thus reduced the general average below that of the average for abscess cases. The explanation is probably to be found in the overwhelming dose of infection which reduced the body reaction. It is impossible, therefore, to decide the pathological lesion present from the leukocyte count alone. The pathological lesion can be judged much more accurately from the differential count than from the leukocyte count. A polymorphonuclear count of between 85 and 90 per cent. indicates the presence of a severe process; above 90 per cent., a dangerous condition probably complicated by peritonitis; below 80 per cent., safety for the time being; between 80 and 85 per cent., a doubt. These rules held good for about four-fifths of the cases, there being many exceptions to each rule. One point, and probably the most important that this investigation has taught Pease, is that it is impossible to decide from the blood count alone what pathological lesion we shall find, or even to determine whether the case is severe or not. There are many exceptions and these we must learn to interpret by other means at our command.

THERAPEUTICS.

UNDER THE CHARGE OF

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The Treatment of Pellagra.—BABES, VASILIN, and GHEORGHUS (*Berl. klin. Woch.*, 1909, xlii, 237) refer to a previous report on the use of atoxyl in 65 cases of pellagra, of which 35 were cured, while the remainder were improved, with the exception of six patients with chronic mental trouble and grave complicating disorders. Following the publication by Loeffler of the successful treatment of trypanosomiasis in guinea-pigs by a combination of atoxyl injections with internal and external applications of arsenic, they resolved to try this therapy in pellagra. Their patients were treated in the following manner. They were given an injection of atoxyl, 0.5, at the same time 1 to 5 mg. of arsenous acid in pills and an inunction of 5 grams of a salve, containing arsenous acid in proportion of 1 to 50. Mild cases received a single combined treatment as above. In other cases this was repeated on the succeeding day. In severe cases the treatment was repeated after an interval of a week on two successive days. This method of treatment was applied in 14 cases of pellagra, and was attended with remarkable results. Within one to four weeks complete cure resulted in every case. None of the cases required more than four applications of the combined treatment. The cures included both acute and chronic cases, some of the latter having suffered for as much as twenty years. All symptoms seemed to be equally favorably influenced; that is, erythema, œdema, mental symptoms, diarrhœa, etc. It is too soon to speak of a permanent cure, but the results obtained were very striking.

The Treatment of Sciatica by deep Perineural Infiltrations of Salt Solution.—HECUT (*Jour. Amer. Med. Assoc.*, 1909, lii, 444) reviews the results of deep intraneural and perineural injections of various solutions in the treatment of sciatica. He includes his personal observations in sixteen cases of sciatica treated by injections of alcohol, normal salt solution at body temperature, normal salt solution refrigerated to zero centigrade, and β -eucaine salt solution. His conclusions as to the proper technique and the best solutions are based upon the conclusions of many different observers less than upon his own personal observations. He condemns the injection of alcohol in sciatica because of the danger of subsequent motor paralysis. This is accounted for by the fact that the sciatic nerve contains both motor and sensory filaments and its fibers are essentially terminal. The results have been less dangerous in treating the trigeminal nerve, because, though containing motor fibers, it has rich anastomoses with the seventh nerve and the filaments of the different branches anastomose with each other, and the nerve is therefore capable of some regeneration if degenerative changes occur. He

quotes the results of various observers, as follows: Schloesser reported thirty-six cases of sciatica treated by alcohol injections, with thirty-six cures. Erb, of Heidelberg, Fischler, Brissaud, Levy, and Baudoin, of Paris, tried injections of alcohol, with many negative and not a few disastrous results. Experiments on animals have shown that alcohol exerts a markedly destructive action upon the medullary sheath and axis cylinder of the nerves so treated, but that cocaine and salt solution did not have this effect. Lange was the first to inject normal salt solution at body temperature, using large quantities, 80 to 120 c.c. Lange also made use of β -eucaine salt solution at body temperature injected in amounts of from 60 to 100 c.c. He treated 56 cases in all, of which 65 per cent. were completely cured, 10 per cent. were improved, and 10 per cent. had a recurrence. In 15 per cent. of his cases the result was a total failure. Schlesinger used normal salt solution refrigerated to zero centigrade in smaller quantities, 10 to 20 c.c. He treated 42 cases with excellent results. Busse has treated 81 patients who had sciatica with injections of an 0.8 per cent. salt solution, and records 63 per cent. complete cures and 21 per cent. improvements. A number of other observers give correspondingly good reports. Hecht prefers the use of normal salt solution of varying temperature and quantity, or the beta-eucaine solution of Lange for the injection. He advises the injection of the sciatic at its point of exit from the great sacrosciatic foramen. Several methods are in use for the determination of this point. Hecht found that he could invariably locate it in the following manner: The patient should lie on the abdomen with fully extended legs and a flat pad placed in the hollow of the groin. A line is drawn with tincture of iodine from the sacrococcygeal articulation to the postero-external border of the great trochanter; at the junction of the inner one-third with the outer two-thirds of this line is the spine of the ischium. Placing the needle a thumb's breadth to the outer side of this point and penetrating in a directly perpendicular line to a variable depth, one engages the sciatic nerve. He uses an all metal syringe of 60 c.c. capacity. The needle is steel, 12 cm. long, with a caliber of 1.5 mm. and provided with a half sharp point which is protected by a dull tipped stylet. The needle fits to the syringe by a slip-tip. The needle with the stylet partly withdrawn is put through the skin, and when well in the subcutaneous tissue the stylet is returned to cover the point and the needle is directed perpendicularly to the necessary depth. The moment the nerve is touched the patient feels a sharp lancinating pain at the heel or in the calf associated with a quick jerky movement. Occasionally the pain is felt in the buttock, thigh, or at the knee. The filled syringe is now attached and the solution injected slowly with steady, firm pressure. Considerable soreness may exist for a while at the point of injection, but this soon passes away. Hecht had no serious accidents or complications. Immediate relief is afforded by the first injection, though several injections may be necessary to effect a cure. He says that a large number of the cases have been followed for from one to four years, and many patients have been entirely free from pain, while under observation. His review of the treatment led him to believe that improvement commonly occurs, that recurrences are not the rule, and that failures are the exception.

Calcium Chloride as Preventive for Serum Sickness.—GEWIN (*Münch. med. Woch.*, 1908, li, 2670) gave every alternate patient in a series of 200, calcium chloride by the mouth when diphtheria antitoxin was injected. He found that in those patients receiving the calcium chloride there was either no disturbance at all or at the most very slight. He gave 1 gram (15 grains) with the larger doses of serum and 0.5 gram with the smaller doses.

The Röntgen Ray Treatment of Blood Diseases.—ELISCHER and ENGEL (*Ztschr. f. klin. Med.*, 1909, i to iii, 31) report 44 cases of leukemia, lymphosarcoma, or mediastinal tumors treated by the Röntgen rays since 1904. They include in this report the detailed histories. They believe that it is most important to apply the treatment in the early stages. When applied later the rays must be more intense and consequently there is much more danger. In the early stages of cervical glandular processes and mediastinal tumors there need be no fear of destroying large masses of tissue with the consequent intoxication. They advise the use of the rays in all cases of enlarged cervical glands because of the difficulty in the early differentiation of a simple or tuberculous adenitis from a lymphosarcoma or a pseudoleukemia. They advise strong daily exposures of eight or ten minutes for from ten to fourteen days. The exposures are then suspended in order to determine the patient's sensitiveness to the rays. After a period of observation the treatment is resumed until signs of improvement appear. In a few cases the rays will be found without value. If good results are not obtained with ten minute exposures, the treatment must be stopped, since a longer exposure would inevitably result in a burn. The exposures are kept up two or three months in the case of a mediastinal tumor. They say that the early treatment is of even greater importance in leukemia. Shorter exposures must be made with great caution to avoid injuring the capsules of the spleen and to prevent toxic symptoms. The main point in leukemia is to work with as small a dosage of the rays as is possible, utilizing the late action of the rays. After eight or ten exposures the treatment is suspended for a week. With careful watching of the patient's blood and weight, and a renewal of the treatment whenever the least sign or symptom of a recurrence occurs, they believe that the fatal outcome may be long postponed. They think that an acute exacerbation is more liable to occur in the cases treated by radiotherapy. In one case six courses of treatment were given during three and one-half years, always with marked benefit, but no authentic case is on record of actual permanent recovery. The tissues seem gradually to acquire an immunity to the action of the rays, which then become useless. Of the 19 cases of leukemia treated, 10 of the 13 myeloid type and 2 of the 6 lymphatic variety were much improved by the treatment. The prognosis of the result of the radiotherapy cannot be accurately made in many cases. The prognosis does not especially depend upon the length or the severity of the disease. In general, acute cases and chronic cases with acute symptoms, such as fever and a rapid loss of weight, derive little benefit from the treatment. A review of the literature shows that radiotherapy has a favorable influence in 90 per cent. of the myeloid type and in 65 to 70 per cent. of the lymphatic variety.

The Influence of Certain Drugs upon Peptic Digestion.—ASCHER (*Archiv f. Verdauungskrank.*, 1908, vi, 629) has performed some experiments with a number of drugs in order to determine their action upon pepsin digestion. He used Jacobi's ricin test as a measure of the amount of proteid digestion in test-tube experiments. He found that solutions of sodium chloride, sodium sulphate, and potassium iodide had no effect unless in concentrated solution. On the other hand, alcohol, sodium salicylate, different preparations of iron and arsenic, all inhibited more or less completely peptic digestion. Iron especially had a marked inhibitory action. Of the preparations of arsenic, atoxyl and sodium cacodylate had less of this action. He also determined that lactic and acetic acids did not affect the digestion of proteid in the presence of decinormal HCl unless in considerable concentration. The use of decinormal lactic or acetic acids in place of decinormal hydrochloric acid in the test-tubes caused very little digestion of proteid. His experiments showed that small quantities of tannin and of the bitters, quinine and condurango, markedly inhibited the action of the peptic ferment.

Changes in the Size of the Heart Induced by Hot and Cold Baths.—BECK and DOHAN (*Münch. med. Woch.*, 1909, iv, 171) made a series of observations regarding the influence of hot and cold baths upon the size of the heart. An orthodiagram of the heart was taken before the baths, a second one directly after, and in some of the cases a third was taken twenty to sixty minutes after the bath. They found that after the hot baths (104° to 106° Fahrenheit) there was a considerable diminution in the apparent size of the heart in six of the seven cases. There was no apparent change in the seventh case. After cold baths (68° to 77° Fahrenheit) they found in four of the five cases an increase in the size of the heart. Three showed a very considerable increase. They also noted that the hot baths increased the pulse rate and lowered the blood pressure, while the cold baths did the reverse. Some think that this is explained by a reflex action on the vagus and accelerator nerves, hot baths stimulating the accelerator and inhibiting the vagus, and cold baths vice versa. They think that probably the important action is an altered distribution of the blood in the body.

The Treatment of Acute Articular Rheumatism.—PLEHN (*Deut. med. Woch.*, 1908, li, 2201) says that the success of the salicylate treatment of acute articular rheumatism depends on sufficient dosage. When so given, he thinks the action of salicylic acid is as specific as the action of quinine in malaria or of mercury in syphilis. He gives 1 gram every two hours, so that the patient takes 6 grams a day, suspending the medication at night. This is continued until the temperature has been normal for three days and all joint symptoms have disappeared. He then gives 4 grams a day for a week. Three further days in bed without drugs are insisted upon before the patient is allowed to get up. The painful joints are dressed with dry cotton and supported on cushions. This method is applied to every case, no matter how mild it may seem, and he regards it as the minimum dosage necessary for the proper treatment. Women, as a rule, do not tolerate such large doses, and he consequently reduces the dosage to 5 or even 3 grams a day. As a rule, the dosage should correspond to 0.08 gram per kilogram of body weight.

In 319 cases so treated, with the heart normal, valvular trouble developed in only two cases, and in these this method had not been carried out strictly. In 101 cases of recurring rheumatism, in which the first attack had been treated elsewhere, heart trouble developed in 36 cases. Plehn is convinced that this method of early, vigorous, and long-continued salicylate treatment saves the patient from complications on the part of the heart and pleura. He believes that salicylic acid in doses of 8 grams a day, continued for long periods of time, has no toxic effect upon the heart. It can be given without bad results in chronic valvular disease and myocarditis. He says that existing acute or chronic nephritis was always favorably influenced by this treatment. He believes that baths and packs reinforce the action of the drugs, but never take their place. He suggests for the rare cases which resist the salicylate treatment either the intramuscular injection of quinine with antipyrin or the intravenous injection of colloidal silver.

The Effective Treatment of Acute and Subacute Rheumatism.—LEES (*Brit. Med. Jour.*, 1909, i, 146) believes that rheumatic fever is a specific infectious disease, the manifestations of which differ widely in children and in adults. He believes that in childhood the heart is always affected to a greater or less degree, but that the joints may only be slightly and often not at all affected. When it attacks adults, the most prominent manifestation is an arthritis. He attributes to the salicylates a specific action against the rheumatic microbe or poison. For this purpose the salicylates must be given in sufficiently large doses. He believes that practitioners are satisfied ordinarily with the cure of the more easily controlled manifestations—the arthritis and the pyrexia. He deprecates this attitude and speaks for the more energetic use of the salicylates to ward off cardiac complications. The addition of double the amount of sodium bicarbonate to each dose of the salicylate will help to prevent the unpleasant symptoms which may prevent the use of a sufficient amount of sodium salicylate. The initial dose for an adult should be 15 grains given every two hours from 6 A.M. to 10 P.M., or 150 grains daily. A child aged from seven to twelve years should receive 10 grains every two hours, or 100 grains daily; for a child younger than seven, 5 grains at a single dose, or 50 grains a day. The amount of the daily dosage should be increased each day, or every second day, until unpleasant symptoms are produced. These are deafness, tinnitus, vertigo, vomiting, etc. Drowsiness in children, an acetone odor to the breath, or acetonuria, with slowing and deepening of the respirations, are danger symptoms. He points out that these symptoms may be entirely prevented by the relief of constipation and the use of sufficient sodium bicarbonate. The daily increase of the dosage may be from two to 5 grains in the individual dose. The amount needed for a child may be nearly as great as for an adult, for in a child the infection is more virulent and more often affects the endocardium. In a child, also, the drug is eliminated more quickly in the urine. In mildly acute and subacute cases a daily dose of 150 grains may be sufficient, but in many it is necessary to increase this to 200 and 250 grains a day, and in some severe cases to 350 and 400 grains. Chorea may require 250 to 400 grains daily.

PEDIATRICS.

UNDER THE CHARGE OF

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Report of Ten Cases of Epidemic Cerebrospinal Meningitis Treated with the Antimeningitis Serum.—J. D. MORGAN and W. W. WILKINSON (*Arch. Int. Med.*, 1908, ii, 256) report their experience with 10 cases of epidemic cerebrospinal meningitis treated with antimeningitis serum; 7 of these were in children and adolescents; 7 (5 children) of the patients recovered, and 3 (2 children) died, giving a mortality percentage of 30; one of the deaths was in a case of chronic hydrocephalus, and, omitting this patient, the mortality percentage is 22. Following the serum injection there was usually considerable improvement in the clinical symptoms. The course of the disease was considerably modified, an average of twenty-three days for all 7, and in 5 of the cases fifteen days. Only 2 of the patients, who recovered, suffered from sequels. The serum caused a marked diminution in the number of diplococci in the spinal fluid, a disappearance or degeneration of the organism in coverslips, and in the majority of cases its growth was promptly inhibited. Phagocytosis was either unchanged or increased. In 5 out of 8 cases the leukocytes showed degenerative changes following the serum injection. This explains the rapid clearing of the spinal fluid observed following the injection. The leukocyte count rose in 3 cases, in all of which the patient recovered. It fell in 5 cases, in 2 of which the patients died.

Blood Examinations in Nurslings Afflicted with Hereditary Syphilis.—H. RISEL (*Münch. med. Woch.*, 1908, lv, 2160) publishes the results of 51 blood examinations of 20 infants known to have hereditary syphilis. Of these children, one was less than one month old, 6 were in their second month, 8 in their third month, 4 in their second quarter, while one was almost one year old. In all of them the hemoglobin was reduced; the same was true of the red corpuscles. In lighter cases their number averaged about 3,000,000; in graver cases it fell to as low a point as 1,500,000. In such cases other disturbances of red corpuscles were also noted, such as variations in the size of the cells, poikilocytosis, basophilia; and in very grave cases also basophilic granulation. Nucleated red corpuscles were found in all cases with the exception of the very lightest ones; in graver cases microblasts and normoblasts with pyknotic nuclei appeared in the blood, while in the gravest types there were normoblasts with radial nuclei and megaloblasts. In even the lighter cases the erythroblasts amounted to about 5 per cent. of all the nucleated cells, while in one instance they amounted to even 27 per cent. In only 14 of the cases was a marked leukocytosis (over 20,000) observed, thus showing leukocytosis to be relatively rare. It is usually associated with the appearance of septic complications or bronchopneumonia. In most of the cases the leukocytoses are of a

polynuclear neutrophilic character. In favorable cases there may be also lymphocytosis with high leukocytic values, but it is much more frequent, particularly in grave cases, to find lymphocytosis with normal number of leukocytes. No definite explanation can be found for the basophilic and eosinophilic polynuclear leukocytes, but the mononuclears are always increased in grave cases. In most instances isolated myelocytes are found, the percentage varying from 0.5 to 5.6 per cent. in the grave cases; the greater the number the more unfavorable the prognosis. The myelocytes are of a neutrophilic and eosinophilic character. The myelocytic picture is usually accompanied with a large number of erythroblasts. The gravest blood changes were found in the youngest of the children. As all of these were breast-fed children, this can with right be attributed to the syphilitic infection. Clinically all these had enlarged livers and spleens, and a number of them presented pseudoparalyses of some or all of the extremities; 13 of the patients died.

The Influence of Phosphorus Cod-liver Oil on the Metabolism of Healthy and Rachitic Nurslings.—W. BIRK (*Monats. f. Kinderheilk.*, 1908, vii, 450) bases his observations upon a study of four children between the ages of eight and ten and one-half months; two were in good health, the others were rachitic. First, the metabolic changes were noted for three days, the food given being the ordinary diet given such children at the Breslau children's clinic. They were then given from two to three times daily one-half to one teaspoonful of a phosphated cod-liver oil; a week later the influence of this medication on metabolism was noted over another period of three days. The results confirm the favorable results of this oil on rickets. The results of the experiments are thus tabulated: (1) It was determined that in some rachitic children the mineral excretion was greater than the amount of such salts taken up. (2) In such cases the phosphated oil produced an improvement, as judged by the increased retention of ash, calcium, and magnesium. The phosphorus metabolism was not markedly influenced by the phosphated cod-liver oil. (3) The organism was not found deficient from the standpoint of retaining function. (4) Neither was the amount of minerals taken deficient in amount; as soon as the phosphated oil was given, the retention increased even though the amount of mineral substances taken in was not increased. (5) The condition, therefore, must be the result of a pathological excretion of these salts. (6) The digestion of fats in the intestine was also favorably influenced by the oil; an antagonismal state exists between the formation of soap and retention of lime: as the lime retention increases, the soap formation decreases. (7) The favorable action of the phosphated oil must in some way be connected with this change in soap formation.

Lordotic Albuminuria.—H. NOTHMANN (*Archiv. f. Kinderheilk.*, 1909, xlix, 216) agrees with Jehle, who found that the so-called orthostatic albuminuria was not due so much to a change from the horizontal to a vertical position, but rather to a lordotic deformity of the spine. Notlmann observed that all cases of orthostatic albuminuria were in such individuals, and that lordotic albuminuria existed in patients

who had otherwise no symptoms or signs of kidney disease. He was able to produce such an albuminuria by placing patients, who ordinarily had no albuminuria, in a lordotic position while in bed, the albumin disappearing when the position was altered. He was able to increase the amount of albumin by placing patients with renal disease in a lordotic position, and he was able to reproduce it in patients in whom the albumin had disappeared altogether, simply by forcing such a position. A more marked degree of lordosis is necessary to produce an albuminuria in a healthy individual than in one with nephritis. From a series of observations of the albuminuria of scarlet fever patients he concludes that it is frequent, usually slight, generally lasts but a short time, but may return during the course of convalescence several times; there may or may not be an organic sediment; it may appear with the patient lying quietly in bed or after he rises; it may be associated with other sequels or may be the only remaining injury of the disease. In all convalescents, however, the same albuminuria and acetic acid precipitate could be produced by inducing a lordosis, and in no patient in whom the lordotic experiment was negative were there ever symptoms of a pathological or functional kidney disturbance noted. The cause of the albuminous excretion after scarlet fever is more of a functional than pathological nature. The anatomical change is probably a slight "catarrh of the uriniferous tubules." The disease is benign and disappears usually in a few days to weeks, the patient resting quietly in bed.

OBSTETRICS.

UNDER THE CHARGE OF

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The Treatment of Placenta Prævia.—SELLHEIM (*Monats. f. Geb. u. Gyn.*, 1909, xxix, 1) writes an open letter to Professor Martin urging the claims of extraperitoneal suprasymphyseal Cesarean section in the treatment of placenta prævia. Sellheim urges that the tedious uncertain methods of vaginal dilatation, with their mortality and morbidity, should be abandoned in placenta prævia in favor of modern surgical operations. He urges as a reason for this the great improvement in mortality and morbidity and the more prompt and lasting convalescence of the mother. The method of Cesarean delivery which Sellheim urges consists in opening the abdominal wall just above the pubes, taking care to avoid the peritoneum; the emptied urinary bladder is carried strongly downward or else above the brim of the pelvis, while the peritoneal sac is pushed upward; the operator thus seeks to avoid opening the peritoneal cavity. The lower uterine cervix, and, if necessary, the cervix, is incised sufficiently to deliver the child. If there is sufficient dilatation, the placenta may be expressed through the vagina, or, if such is not the case, it is manually removed. Should there be a tendency to

hemorrhage, the uterus is tamponed with iodoform gauze, which is subsequently removed through the vagina. If the case is septic the wound may be left open, the edges of the uterine wound being sutured to the margins of the abdominal wound. The uterus may then be drained with gauze. A uterine fistula is thus established, which is allowed to close spontaneously as the patient recovers.

The Toxicoses of Pregnancy.—FELLNER (*Monatschr. f. Geb. u. Gyn.*, 1909, xxix, 1) calls attention to the disturbances in the secretory nerves occasioned by pregnancy. Should toxemia develop, the nervous system becomes greatly disturbed. Fellner has endeavored to ascertain the exact factor in eclampsia which produces these psychic developments. He believes that the placenta plays an important part, because in several cases he has observed a cessation of the psychosis following the removal of retained placental tissue. He believes that an exaggeration of physiological processes, rather than the development of an entirely new pathological condition, causes these conditions. He draws attention to some of the phenomena of menstruation as similar to eclampsia and also the characteristic pain of osteomalacia.

The Management of Labor in Contracted Pelves is the title of an interesting book by BÜRGER, assistant in the first obstetric clinic in Vienna. This book, so far as we know, has not yet been translated into English. The material studied was 4240 cases of contracted pelvis occurring among 49,375 patients, a percentage of 8.5. The book is written from Pinard's standpoint, but we may hope that obstetric science will reach that point where no child will be sacrificed in the interest of the mother. Contracted pelvis are divided into four classes, the true conjugate of the fourth being 6.5 cm. Cases of atypical contraction are not considered, as each case must be considered upon its individual merits. Cases complicated by eclampsia, placenta prævia, or in which the child weighed less than four and one-half pounds, are also excluded. The general plan of treatment employed has been an expectant one. If the conjugata vera measured 8 cm., except in simple flat pelvis, spontaneous labor was not expected. Symphysiotomy was performed for conjugata vera between 9 and 7 cm. The highest application of the forceps was always tentative and never forcible. The lowest forceps application was made only when danger threatened the mother or child. In breech cases the finger in the groin was the only method of making traction advisable.

The percentage of spontaneous deliveries was high. In primigravidae with flat pelvis, when the true conjugate was between 8.5 cm. and 7.6 cm., there were 56.4 per cent. of spontaneous deliveries. With primigravidae having generally contracted pelvis, with the same true conjugate, there were 62.7 per cent. of spontaneous deliveries. When the true conjugate was from 7.5 to 6.5 cm., the percentage of spontaneous deliveries varied from 9.95 to 18. In general, varying with the degree of contraction, there were in all kinds of contracted pelvis, from 89 to 9.9 per cent. of spontaneous deliveries. Bürger thinks that prophylactic version should seldom be performed. Premature labor was induced in only 0.6 per cent. of all cases of pelvic contraction, and 47 per cent. of the infants were lost.

Bürger believes that the induction of premature labor should be reserved for cases in which the patient has borne previously large and well-developed children, where some of the difficulties in delivery can undoubtedly be overcome by the mother. If the induction of labor is not followed by spontaneous delivery, vaginal delivery is rarely indicated, and in highly contracted pelvises should never be attempted. Symphysiotomy is replaced by hebotomy. This operation was done twenty-three times, with no maternal mortality, and with the loss of one child. If both mother and child are to be saved, there is no question that Cesarean section is the preferable operation. Hebotomy is less dangerous for the mother, and in selected cases not much more dangerous for the child. Bürger believes that in the future premature labor and prophylactic version will very rarely be performed. Hebotomy will take the place of some cases in which Cesarean section is now performed.

GYNECOLOGY.

UNDER THE CHARGE OF

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The Ureters after the Radical Abdominal Operation for Carcinoma of the Uterus.—W. WEIBEL (*Zeitschr. f. Geb. u. Gyn.*, 1908, lxii, 184), as assistant to Wertheim, reports the occurrence of ureteral fistulæ in 24 out of 400 cases operated upon for carcinoma of the uterus. In 3 cases there was a fistula of each ureter. It is believed that the fistulæ in all cases arose from necrosis due to extensive dissection interfering with the blood supply of the uterus. Actual injury to the ureters during operation occurred 8 times in the first 200 and 3 times in the last 200 operations, and was in nearly every instance observed at the time and successfully remedied. The fistulæ appeared never earlier than the seventh nor later than the eighteenth day after operation, and were usually observed during the second week. Spontaneous healing occurred in 13 out of the 24 cases, beginning in one instance as early as the second week after the appearance of the fistula and taking place in another case as late as the fourth month. Usually spontaneous closure took place between the third and twelfth weeks; 2 of the 3 cases of bilateral fistula healed spontaneously. A nephrectomy was performed in 7 of the 11 cases in which spontaneous healing did not occur after long intervals, and is the operation recommended under such conditions. Cystoscopic examinations in cases of fistula followed by spontaneous healing showed in most cases a marked prolongation of the interval between contractions of the affected ureter as compared with the normal one, and in many cases a diminution in the intensity of the stream of urine. No other symptoms were observed in such patients.

Prolapse of the Rectum and Sigmoid Flexure following Hysterectomy.—L. J. HIRSCHMAN (*Jour. Amer. Med. Assoc.*, 1908, li, 1125) reported 2 cases in which such prolapse had occurred, and believes this result should be remembered in doing hysterectomy. Hirschman believes that when chronic constipation exists before hysterectomy the broad ligaments should be sutured together and proper treatment be addressed to injuries of the vaginal wall and perineum; that when any tendency to prolapse of the rectum or sigmoid is observed, mesosigmoidopexy should be done as a prophylactic measure, and that this operation should be the one of choice in every case of complete prolapse of the rectum and sigmoid, whether following hysterectomy or from other causes, as it holds the sigmoid in place by its natural support.

Intraligamentous Fibroids.—ERDMANN (*Amer. Jour. Obst.*, 1908, lviii, 861) says that he is convinced fibroid tumors developing within the broad ligament and independently of the uterus are by no means rare; the text-book descriptions of them are very meagre and the literature of the subject is very limited. Erdmann reports 4 cases in which he has operated removing the tumor and body of the uterus in each instance. Erdmann thinks the growths develop entirely from the broad ligament structures and that the differential diagnosis is based upon their usually slow growth, the elongation of the vagina, with a tumor, harder upon palpation than a cyst, with markedly limited mobility, more marked on one side of the pelvis, and the uterus, practically normal in size, tilted greatly to the unaffected side. Erdmann believes, however, that one cannot make a positive diagnosis before opening the abdomen, and refers to two chief dangers in their removal, hemorrhage from the iliac vessels or some of their branches and ureteral trauma.

Ureterovesical Anastomosis.—R. L. PAYNE (*Jour. Amer. Med. Assoc.*, 1908, li, 1321) reports 2 cases of this surgical procedure done by a method that is claimed as new. In 1 of them Payne loosened the corresponding kidney and depressed it to lessen the tension on the newly made junction of the bladder and the ureter. Payne does not mention whether in his 2 cases he avoided the misfortune of the formation of calculi about the portions of the sutures exposed to the urine, as has been recorded by many surgeons.

Early Rising after Laparotomies.—F. COHN (*Zentrbl. f. Gyn.*, 1908, xxxii, 1233) comments on the results secured in 100 laparotomies in which the patients were allowed to get out of bed during the first week after operation, 13 arising on the first day, 16 on the second, 21 on the third, 30 on the fourth, 10 on the fifth, 8 on the sixth, and 2 on the seventh. Embolus was not observed. There were 3 cases of thrombosis, each of which was attributed to causes other than the early getting out of bed. One occurred in a woman, aged seventy years, from whom an immense ovarian cyst had been removed, and 2 in patients who had a moderate degree of fever previous to operation. The author advises caution in permitting the early getting up of patients who show before operation a rise in temperature or a disturbance in the circulation in the pelvis or lower extremities.

The Conservative Surgeon and the Symptomless Uterine Fibroid.—THOMAS B. EASTMEN (*Jour. Amer. Med. Assoc.*, 1908, li, 972) refers to the 12 per cent. of carcinomatous, sarcomatous, necrotic, and myxomatous degenerations as conditions, which if not removed will, at least, in all probability, terminate fatally, and if not removed such developments will occur as will render subsequent surgical procedure much more difficult and less productive of satisfactory results, as well as being conditions that in the majority of cases could exist unknown and even unsuspected by the examiner. Eastmen also refers to conservative surgeons removing benign growths from other parts of the body as well as the vermiform appendix after the subsidence of an inflammatory attack of that structure, and pleads for application of the same conservatism in the surgical treatment of uterine fibroids.

Ectopic Gestation with a Viable Child.—WERDER (*Amer. Jour. Obst.*, 1908, lviii, 796) advocates prompt abdominal section and total removal of the child and the placenta in cases of ectopic pregnancy with a viable child. Upon the fact that most of the blood supply to the placenta comes from the ovarian vessels and the uterines at the cornua of the uterus, Werder bases the plan of procedure he proposes, and which is as follows: After opening the abdomen, first secure the vessels in the infundibulopelvic ligament and then the vessels at the junction of the uterus and the Fallopian tube. If the pregnancy sac prevents exposure of these points, then compression of the aorta after delivery of the foetus should be applied until the vessels mentioned can be secured, which is usually after considerable dissection. Then the foetal sac and the entire placenta should be removed. For compressing the aorta Werder prefers Halstead's metal band or an ordinary broad clamp, the blades of which have been protected by rubber tubing, such as an intestinal clamp. This should not be tightened until after delivery of the child. The sac and placenta may then be removed leisurely.

Malignant Adenoma of the Cervix Uteri.—F. KLINGER (*Ztschr. f. Geb. u. Gyn.*, 1908, lxiii, 56) reports a case of adenoma of the cervix which developed so rapidly that in the course of four weeks from the first examination an operation was no longer considered advisable. He discusses the literature of this subject and concludes that instead of there being 20 cases on record, as estimated by Schidkowski, there are only 5 including the 1 here reported. He restricts the term to a malignant neoplasm in which the irregularly developed glands show only one epithelial layer.

The Anatomical, Physiological, and Pathological Relationship of the Uterus and the Stomach.—F. J. TAUSSIG (*Jour. Amer. Med. Assoc.*, 1908, li, 1005) states that if we exclude, first, the cases in which physical conditions in the abdomen through relaxed walls and pelvic floor have caused gastric and uterine symptoms; second, the cases in which the condition of the blood, as in anemic or chlorotic individuals, causes altered function on the part of both the stomach and the uterus; third, the cases in which there is hysteria, neurasthenia, or a general neurotic temperament; and finally, those of toxemia of various kinds, little is left to be called reflex neurosis. A few cases, doubtless, will be found

but these will be constantly lessened as pathology is better known and methods of diagnosis become more accurate. Taussig thinks that until a better understanding of the anatomy and physiology of the sympathetic nervous system is had, conservation in assertions regarding reflex neuroses of the stomach and uterus should be used and, more particularly regarding advocacy of operative intervention for the relief of such symptoms.

Metastases in the Central Nervous System and Organs of Special Sense from Carcinoma of the Uterus.—H. OFFERGELD (*Ztschr. f. Geb. u. Gyn.*, 1908, lxiii, 1) calls attention to the rare occurrence of metastases in the nervous system following primary carcinoma of the uterus, stating that only about 30 such cases have been reported. In a total of 6650 cases of uterine cancer reported by six authors this condition was found in only 3 instances. Metastatic growths from cancer of the uterus are much less frequent in the nervous system than in the liver and lungs, but more frequent than in the spleen, heart, adrenals, and thyroid gland. Metastatic carcinoma may develop in any part of the central and peripheral nervous system, including the meninges. Metastases in the brain, which may appear relatively early and even in cases deemed operable, are apt to be associated with secondary growths elsewhere, especially in the liver and lungs, and are all of hematogenous origin. They are usually solitary, rarely as large as a hen's egg, and usually give rise to no clinical symptoms. Metastases in the dura occur usually in inoperable cases, and are for the most part small but multiple, of lymphogenous origin, and give rise to no clinical symptoms. Metastases of the peripheral nerves occur in the pelvis, and are probably much more common than has been suspected. Only in very advanced cases has carcinoma of the uterus been known to give rise to metastases in the organs of special sense, and these are probably hematogenous in origin.

The Vesico-vaginal Interposition of the Uterus.—F. PETRI (*Ztschr. f. Geb. u. Gyn.*, 1908, lxiii, 559) calls attention to the frequent relapses (30 per cent.) following operations for prolapse of the uterus, appendages, and vagina when the operation was restricted to the vaginal wall and perineum, and describes his manner of performing Schauta's operation, in which the uterus is inverted and fastened between the vagina and bladder. He reports 14 cases. Of 11 of these, only 2 showed any relapse after six to twenty-one months and these were in old individuals in whom there was much atrophy of the uterus. Two died of intercurrent affections and one met with an accident soon after the operation, in which the uterus was torn loose from the vaginal wall and the bladder. In the latter instance a ventrofixation of the uterus was subsequently performed. Petri summarizes the results reported up to the present time by other operators following either Schauta's or Wertheim's method, or a combination of the two. Bucura had 1 relapse in 16 cases; Schauta, 1 severe and 2 slight relapses in 40 cases; Doederlein, 1 severe and 9 slight relapses in 44 cases; Krönig, 1 slight relapse in 15 cases; Fuchs, 1 relapse in 20 cases; and Scharpenak, 5 relapses in 45 cases subsequently examined.

The Vaginal, the Vertical Abdominal, and the Pfannenstiell Incisions.—E. E. MONTGOMERY (*Jour. Amer. Med. Assoc.*, 1908, li, 912) states the advantages and disadvantages of each of the incisions mentioned in the title of his paper. As advantages of the vaginal incision or route into the pouch of Douglas, Montgomery states: (1) That drainage is from the most dependent part of the peritoneal cavity. (2) In a fair proportion of cases it permits the cure of the patient by a less radical procedure. (3) The convalescence of the patient, even after hysterectomy, is more rapid and attended with less discomfort than is associated with the same procedure through the abdomen. (4) Ventral hernia and ventral adhesions are obviated. (5) In proper cases it permits the amputation stumps of the ligaments of the uterus to be brought outside the peritoneal cavity, thus facilitating the control of possible secondary hemorrhage. The disadvantages of this route are given as: (1) Insufficient exposure of the field of operation to sight. (2) Extensive intestinal adhesions are unrecognized or form subsequent to operation and cause obstruction. The advantages of the vertical abdominal incision in the median line are: (1) A thorough inspection of the pelvic contents is afforded, and it is capable of being extended to permit inspection and palpation of the abdominal viscera. (2) The various complications found may the more readily be promptly treated. Of the disadvantages Montgomery mentions, dependent drainage is not applicable, and there is danger of infection of the abdominal wound with subsequent hernia and a disfiguring cicatrix. The advantages of the Pfannenstiell incision are: (1) It permits a larger exposure of the field for a comparatively small incision. (2) The probability of subsequent hernia is lessened, as the interior and middle lines of closing sutures are at right angles to each other. (3) The incision through the skin is subsequently hidden by the regrowth of the pubic hair. The disadvantages of it are: (1) Its limited application, being too small for removal of large tumors and exploration of the abdominal contents. (2) The necessarily large opening of the cellular tissue renders possible extension of infection to the wound in cases of pelvic pus accumulations.

OPHTHALMOLOGY.

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The Effect of Sclerectomy upon the Circulation of the Eye.—Sclerectomy has hitherto been regarded as favoring the excretion of the intra-ocular fluid solely by the creation of a filtering cicatrix or fistula. BETTREMIEUX (*Clin. optal.*, December 10, 1908, 370) suggests that the ablation of a superficial layer of the sclera brings the deeper vessels of that structure into relation with the vascular network of the conjunctiva

and the subconjunctival tissue; anastomoses result and a collateral circulation is established which favors the outflow of fluid from the interior of the eye. Upon this view sclerectomy is held to be analogous to the creation of adhesions between the epiploön and the abdominal wall to improve the circulation in cirrhosis of the liver.

Mikulicz's Disease.—In RANDOLPH'S case (*Ophth. Record*, January, 1909, 19) there was enormous symmetrical enlargement of the lacrymal glands, compelling the patient to throw the head back so as to see between the narrowed palpebral aperture. The enlargement entirely disappeared after three months, during which a course of potassium iodide had been administered. The parotids began to enlarge after the swelling of the lacrymal glands had disappeared; the right parotid reached the size of a hen's egg; the left was about one-half as large.

Cortical Motor Centres of the Ocular Muscles.—From experiments upon apes, LEVINSOHN (*Ann. d'ocul.*, September, 1908, 217) comes to the following conclusions: Central motor innervation is very important in the ape; it has its seat in the posterior half of the frontal lobe, the angular gyrus, and the occipital lobe. The region anterior to the pre-Rolandic fissure is the most excitable, the occipital lobe next, and the angular gyrus least. Each of these regions is capable of stimulation by itself. Stimulation of the cortex causes primarily contraction of the muscles excited; inhibition of the antagonists is secondary. Extirpation of the cortical zones is almost entirely negative; rapidly disappearing conjugate deviation occurs; the function of lateral movement is preserved.

Peripheral Iridectomy in Glaucoma.—To maintain the action of the sphincter and prevent prolapse of the pillars of the coloboma into the wound, Wölfli (*Klin. Monatsbl. f. Augenhekk.*, November to December, 1908, 534) has proposed and practised in three cases, with satisfactory results, what he terms peripheral iridectomy; that is, excision of a piece of the iris between the sphincter and the periphery, leaving the margin of the pupil intact. The operation is more difficult to perform than ordinary iridectomy, and will occasionally require general narcosis.

Normal Range of Accommodation at Various Ages.—DUANE and THOMAS' determinations (*Trans. Amer. Ophthalm. Soc.*, vol. xi, Part III) differ somewhat from those of Donders; the accommodation in childhood and youth was lower—rarely above 14 D. between eight and thirteen. The range does not seem to diminish much between ten and fifteen years. The maximum may even occur at sixteen or eighteen, although this requires further investigation. The accommodation does not decrease steadily at all ages, but appears to remain about stationary for some years and then diminish rapidly; from twenty-five to thirty and again from thirty-five to forty are periods of special stasis, but further observation is necessary; but an abrupt plunge seems to occur at forty and continue until fifty-one, after which age the accommodation remains nearly constant, diminishing not more than 0.5 in ten years. Certain peculiarities in the behavior of the function were found in individual cases, and unequal power in the two eyes was not very uncommon.

Toxic Symptoms following the Instillation of Homatropine Hydrobromate.—In LE FEVRE'S case (*Ophth. Record*, June, 1908, 283) three instillations, 1 grain to 48 minims, in two hours and a half was followed half an hour later by light headedness and faucial dryness. Thickness of the voice and delirium, with hallucinations of the sight and apparently hearing, were present. There was pronounced muscular prostration and incoördination. Recovery was complete in six hours.

Suppuration in the Right Temporal Region.—GAVIN (*Ophth. Record*, May, 1908, 245) reports that a successful operation for abscess in this region was performed, followed two weeks later by left exophthalmos and suppuration from the left nostril. Incisions between the globe and lower lid failed to find the pus; tapping the antrum was also negative. Acute suppuration of the middle ear next developed, which was relieved but not cured by incising the drum. Complete cure followed a radical mastoid operation.

PATHOLOGY AND BACTERIOLOGY.

UNDER THE CHARGE OF

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ASSISTED BY

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The Difference Between the Typhoid Bacillus in the Animal Body and when Grown on Artificial Media.—The decrease in virulence of bacteria when grown on artificial media is a well-established fact, and morphological differences of the same organism under these different conditions of growth have been described. TSUDA (*Zentrabl. f. Bakt.*, 1908, xlviii, 277) has found that typhoid bacilli when grown in blood serum differ from bacilli grown in artificial media in the same way as the bacilli grown in the animal body do. These differences are both morphological and biological. The bacilli grown on serum and those grown in the animal body have the same strong resistance against the agglutinative and bacteriolytic action of immune serum, but neither has increased resistance to phagocytosis. The author believes that this change probably depends upon the difficulty with which the organisms are united with the amboceptors of the immune serum, and is produced by a property of the blood serum which is not to be identified with the bacteriolytic component.

The Etiology and Pathology of Tetany.—RUDINGER (*Ztschr. f. exp. Path. u. Ther.*, 1908, v, 205) presents a discussion of the literature and of his own experiments in order to advance his belief that all forms of tetany are dependent upon an insufficiency of the parathyroid bodies.

He considers that the principal function of the parathyroid bodies is the neutralization of toxic substances that act upon the nervous system, and when this neutralization is not complete there is either outspoken tetany or a tendency to this symptom complex. When a tendency to tetany is present, the phenomenon may be called forth by a number of conditions which do not so effect normal individuals. This belief is substantiated by a series of experiments on cats, in which, after treatment with various poisons (calomel, morphine, atropine, tuberculin, ergotin, and ether), without producing any change in electrical reaction or other disturbances, both the outer parathyroid bodies were removed. The animals were then observed for fourteen days, during which time some did and some did not develop tetany. Those which did not develop tetany were found to have increased electrical excitability and other signs which indicated that a tendency toward tetany was present. In animals that during the first day's observation showed no tetanic convulsions the electrical excitability was increased, and somewhat indefinite tetany was produced by treatment with the poisons that formerly were inert. The author thinks that the tetany of gastro-intestinal origin is produced by toxins formed in the digestive organs which act upon the organism poorly protected, on account of parathyroid insufficiency, against these intestinal toxins. This idea is held in spite of the fact that normal parathyroid bodies have been observed several times in patients dying with this form of tetany. Rudinger emphasizes two lesions of the parathyroids as being especially frequent causes of their insufficiency—hemorrhage into the parathyroid bodies, which he believes is an important lesion in the tetany of childhood, and tuberculosis of the parathyroids. A number of instances of tuberculosis of these bodies have been reported, and the existence of this lesion may be the cause of the frequency of Chvostek's sign in tuberculous patients. Schlesinger noted this sign 64 times in 133 patients. With a parathyroid insufficiency already established, the symptom complex of tetany may be called forth by many different agencies or conditions. Thus, in spite of the diverse forms of the disease, the symptom-complex may be etiologically and pathologically an entity, with various secondary or determining causes.

Enzymes of Tuberculous Tissue.—OPIE (*Jour. Exper. Med.*, 1908, x, 645), in several previous papers, has shown that the cells of inflammatory exudates contain enzymes which are capable of digesting proteid material. Two types of enzymes were found to be present: one, leukoprotease, which resided in the polymorphonuclear leukocytes and acted in a neutral or alkaline medium; another, lymphoprotease, a ferment peculiar to the large phagocytic cell or macrophage, and active only in an acid medium. Opie and Borker have now devoted their attention to the study of the cells in tuberculous tissue, and find here again that the tuberculous tissue, like the inflammatory exudates, contains the same types of enzymes. Leukoprotease, the ferment which digests in neutral and alkaline media, is present only during the early stages of the process, and its presence and early disappearance is in direct relation to the invasion of the tissue by polymorphonuclear leukocytes. The amount of lymphoprotease, the enzymes which digest in acid medium, increases during the early stages of the tuberculous process, and in this respect

corresponds closely to the invasion and proliferation of the large epithelioid cell, the cell which evidently contains this enzyme. Its activity is greatest just before caseation takes place, and with the advance of caseation its activity diminishes until, when caseation is far advanced, enzymes are almost totally absent. The authors think it not impossible that caseation which, like autolysis, is accompanied by disappearance of nuclei is in part dependent upon the presence in the cells of the active proteolytic enzyme for a time held in check. Injury to cells by products of the tubercle bacillus or partial anemia, and the results of imperfect vascularization of the tuberculous tissue, may have a part in rendering these cells susceptible to self-digestion. A study of the serum from tuberculous pleural exudates results in rather unexpected findings. Under ordinary circumstances the blood serum, in rather small quantities inhibits completely the action of the leukocytic enzymes. The serum from tuberculous pleural exudates, on the contrary, though during the early stages of the exudation it inhibited the action of the enzymes contained in the large phagocytic cells of the lymph glands, soon lost almost completely this power and itself developed very soon active proteolytic properties. The ability to cause proteolysis increased with the age of exudates. Digestion proceeded best with a neutral reaction. At the same time, the blood serum did not show any diminution in its proteolytic properties. The serum from sterile inflammatory pleural exudates differed from that of the tuberculous exudates in that it inhibited the enzymotic action of leukocytes and showed very little if any power to cause proteolysis.

The Results of Local Tuberculin Reactions.—WOLFF-EISNER and BRANDENSTEIN (*Mitt. aus den Grenz. der Med. u. Chir.*, 1908, xix, 381) discuss the results obtained in the two methods of local application of the tuberculin reaction, namely, the conjunctival and the cutaneous (Piquet) reactions. Their material was composed of surgical cases, especially children. Two facts have been brought out against the value of the conjunctival reaction, its uncertainty and its danger to the eyes. Lately, however, the statistics of Dujour show that the danger to the eyes is very slight, and in over 3000 cases Wolff-Eisner and Brandenstein report but three cases showing inflammatory complications. This fact, they believe, indicates that the danger is very slight when the application of tuberculin is properly performed. They have used the reaction in children with tuberculous lymph glands, in which it was formerly considered particularly dangerous, and had but one ill effect, a mild inflammation lasting but fourteen days. The results of the two methods indicate that the conjunctival reaction, when positive, signifies an active tuberculous process, while the cutaneous reaction is positive when a latent lesion as well as an active one is present. In 1500 clinically non-tuberculous medical cases, Stadelmann and Wolff-Eisner found the conjunctival reaction positive in 15 per cent. and the cutaneous reaction positive in 50 per cent. The cutaneous reaction was positive in 75 per cent. of a series of twenty doctors and nurses working with tuberculous patients. The authors advise the use of a weak solution (1 per cent. of tuberculin, Reute-Enock) for the conjunctival reaction, and believe that the two local reactions should be employed together. The diagnostic and prognostic conclusions to be drawn from such use

have proved useful in surgical as well as in medical practice. In tuberculosis of the lymph glands the conjunctival reaction responded only in cases of acute active tuberculosis, and was negative in the chronic or torpid forms in which the cutaneous reaction was positive. The authors reported few failures with either method, but when deductions are properly drawn from the results the local application of tuberculin can be considered a very valuable procedure for diagnosis.

The Coagulation Time of the Blood and Thrombosis in Phlebitis.—HARLOW BROOKS and CROWELL (*Jour. Exper. Med.*, 1908, ii, 271) have carried on experiments with a view of determining what part an artificially increased or decreased coagulability of the blood plays in the production of thrombosis. They used rabbits, and found that they could decrease the coagulation time of the blood one-half by the daily administration of 2 grams of calcium lactate. On the other hand, they found that they were able to increase the coagulation time one-third by the exhibition of 2 grams of citric acid each day. They further found that the maximum effect of these drugs occurs in two hours after their administration, and probably passes off in twelve hours. To induce thrombosis they injured the vessel walls either by means of clamps or by injections of chemical substances or bacterial cultures into the vein or into its surrounding tissues. They concluded from their experiments that mere stagnation of venous blood produced no marked tendency to thrombosis. In their experiments thrombosis was most readily induced when inflammatory lesions existed in the bloodvessels. They think that purely mechanical lesions do not cause thrombosis except at the immediate point of injury to the vessel wall. Marked artificial increase or decrease of the coagulation time of the blood by the use of calcium lactate or citric acid did not render animals more subject to thrombosis incited by changes other than inflammatory. When true phlebitis existed thrombosis was apt to be more extensive, and less readily absorbed when the coagulation time of the blood was shortened by the use of calcium lactate. It was less extensive and more readily absorbed when the coagulation time was increased by the administration of citric acid.

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ORIGINAL ARTICLES.

SHORT-DURATION TYPHOID FEVER.¹

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THE term short-duration typhoid fever is used to include the types of the disease which have been designated ambulatory, abortive, mild, typhus lævis, and typhus lævissimus. These types are not well defined, and it seems desirable to have a term which not only will include them all, but at the same time will point out the very important fact that many cases of typhoid fever do not run the classical twenty-one day course. The mild and ambulatory cases come within the meaning of the term only when they last less than three weeks.

Every year during the typhoid season a limited number of patients enter the second medical division of Bellevue Hospital suffering from a mild febrile disease, without obvious cause, which completes its course in periods varying from about one to about two weeks. During the first years of my service at the hospital, in accordance with accepted beliefs, I regarded these cases as examples of febricula or simple continued fever. In 1901, however, when I undertook with Buxton to study the bacteriology of the blood in typhoid fever, I began to question the correctness of this diagnosis. About this time the paratyphoid infections attracted the attention of numerous investigators in Europe and in this country, and the claim was made by several writers that the paratyphoid could be distinguished

¹ Read at a meeting of the New York State Medical Society, Albany, January 26, 1909.
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clinically from the typhoid cases by their milder and shorter course. With the double purpose of testing this claim and of determining the true nature of the disease or diseases in question, we made bacteriological examinations of the blood of all patients who might be suffering from typhoid fever. The recovery of the typhoid bacillus in pure culture from the blood of several of these cases convinced me that the whole question of the occurrence and diagnosis of the irregular forms of typhoid fever might be profitably investigated.

REVIEW OF THE LITERATURE. Though typhoid fever has been known as a distinct disease for nearly a century, a review of the literature reveals an astonishing state of confusion concerning the very existence of the milder and shorter forms. The history of the diagnosis of typhoid fever falls readily into two periods: (1) The period before the introduction of exact methods of diagnosis; and (2) the period since the application of the Gruber reaction by Widal to the diagnosis of typhoid fever and the general employment of bacteriological methods in the diagnosis of the disease.

First Period. While the diagnosis of a typical case of typhoid fever ordinarily presents no difficulty, supposedly typical cases have occasionally turned out to be acute general tuberculosis. There is no clinical means by which the diagnosis of typhoid fever can be positively established. Therefore the diagnosis of the disease in this period was necessarily a matter of opinion. In a disputed case the diagnosis could not be proved or disproved unless some typical or fatal complication developed and the case came to autopsy. Ordinarily the "weight of authority" prevailed in doubtful cases.

The fact that mild forms of typhoid fever did occur, however, was known very early in the history of the disease. Louis² saw a case of ambulatory typhoid which perforated and came to autopsy. These forms were described by Wegelin³ in 1854, by Griesinger⁴ in 1864, by Murchison⁵ in 1873, and by Liebermeister⁶ in 1874. In 1873 Jurgensen⁷ said that the whole theory of infective diseases is untenable if the existence of milder forms cannot be shown; that transitions from the mildest to the severest must be demonstrated.

Yet during the same period there grew up an extensive literature on mild fevers which were not generally, at least, considered to be typhoid and upon which a variety of names were bestowed. Some of these names may be cited: febricula, simple continued fever, mountain fever, "New York fever," embarras gastrique febrile, fièvre bilieuse simple ou inflammatoire, gastrisches Fieber, and febris gastrica. Fortunately, these names have given place largely to

² Recherches sur la maladie fièvre typhoïde, Paris, 1841.

³ Zurich Thesis, 1854 (quoted from Briggs; original not available).

⁴ Infektskrankh., 1864.

⁵ A treatise on the continued fevers of Great Britain; London, 1873.

⁶ Ziemssen, Path. u. Ther., 1874, vol. ii. Acute Infektskrankh.

⁷ Volkmann's Samml. klin. Vortr., 1870, i to xxxiv; Inn. Med., No. 21, p. 477.

more exact diagnoses. But for many years it was claimed by English army surgeons that there was no typhoid fever in India. As late as 1897, the late Sir Joseph Fayrer⁸ stated that "enteric fever occurs in India as it does in Europe, and most probably has always existed there. It may have been confounded with continued or remittent malarial fever, but it is not by any means certain that a febrile condition accompanied by diarrhoea, Peyerian ulceration, and an abdominal eruption is necessarily caused by the one specific contagium to which it is attributed in Europe." (At the time this was written the paratyphoid infections had not been studied). In the same article the fever morbidity returns for 1892 of the European and native armies in India, numbering nearly 200,000 men, are given: they were 1563 cases of typhoid fever, 96,226 cases of intermittent, 2660 of remittent, and 5618 cases of *simple continued fever*.

Likewise, for many years it was denied by the French army surgeons that typhoid fever existed in Algeria, but Scherb⁹ states that typhoid is more common in Algeria than in Paris. Denis¹⁰ says that typhoid fever in the corps in Algeria is almost as great as in the whole army in France.

It is true that the existence of these fevers as distinct diseases was called into question from time to time. Bäumlér¹¹ said in 1867 that the earlier German idea that there existed a "febrile gastric catarrh" as a distinct and not uncommon disease, which in fully developed form was considered "gastric fever," had been gradually abandoned in favor of the belief that it was typhoid fever. Levy¹² in 1886, and Chantemesse¹³ and Courtet¹⁴ in 1889, expressed the opinion that *embarrass gastrique febrile* was a mild form of typhoid fever.

Undoubtedly one reason for the reluctance of the medical profession to accept, during this period, the belief that the milder forms of typhoid fever occurred frequently was the weight of Wunderlich's¹⁵ dictum, issued in 1868, to the effect that a case of fever, without obvious cause, was certainly not typhoid unless the temperature reached 103.2° between the fourth and sixth days. In the absence of exact methods of diagnosis, one might doubt but not disprove the truth of this dictum. As late as 1897, Dreschfeld¹⁶ referred to it as still possessing value in diagnosis.

Second Period. The second period opens with the announcement by Widal¹⁷ of his application of the Gruber reaction to the diagnosis of typhoid fever. Strange as it may seem, when one considers the

⁸ Allbutt's System, article on the Climate and Some of the Fevers of India, vol. iii.

⁹ Bull. méd. d'Algerie, 1903, 2s, I, 33.

¹⁰ Discussion of Scherb's paper.

¹¹ Deut. Arch. f. klin. Med., 1867, iii, 278.

¹² Thèse Montpellier, 1886, *Embarrass gastrique febrile*.

¹³ Sem. méd., 1889, ix, 421.

¹⁴ Thèse de Paris, 1889, *Embarrass gastrique febrile et typhoïde fièvre*.

¹⁵ Das Verhalten der Eigenwärme in Krankheiten, Leipsic, 1868.

¹⁶ Allbutt and Rolleston's System, article Typhoid Fever.

¹⁷ Soc. méd. d. hôp. d. Paris, 1896, 3s, xiii, 561.

epidemiological importance of the subject, the study of the milder forms of typhoid fever, with the aid of exact methods of diagnosis, has been greatly neglected.

Shortly after the appearance of Widal's paper it was demonstrated in France and Tunis by Lemoine,¹⁸ Catrin,¹⁹ Geraud and Remlinger,²⁰ and Roux²¹ that serum from cases of *embarrass gastrique febrile* gave the typhoid reaction. Woodruff²² showed that this was also true for mountain fever in this country. (It may be stated parenthetically that these results would not be accepted today because the methods of performing the tests have since been shown to be unreliable. Yet these investigations marked a definite advance in the study of typhoid fever.)

In 1904, during the typhoid epidemic in and around Saarbrück, Koch and his co-workers established the typhoid nature of many mild febrile cases of indefinite clinical character. For example, Drigalski²³ obtained a positive typhoid reaction 306 times and recovered the typhoid bacillus from the stools 75 times in 381 doubtful cases. Frosch,²⁴ by the employment of the same methods, discovered 144 cases of typhoid fever in a region where only 8 had been officially reported.

J. P. Bates has published the results of a study of 68 cases of typhoid fever in Panama.²⁵ Twenty-one (32 per cent.) of the cases were of the short-duration variety. The typhoid bacillus or a paracolony bacillus was recovered from the blood in 9 of these cases; in the 12 remaining cases the diagnosis was based upon the serum reaction. A paracolony bacillus was found in the blood of the case of shortest duration (eight days).

Except for the reports by Debie²⁶ and Briggs²⁷ these are the only papers I have been able to find in which the attempt is made to prove that the milder forms of typhoid fever have often been concealed under the names simple continued fever, mountain fever, etc. A number of papers have been written in which the authors express the belief that short-duration typhoid fever is of common occurrence and often overlooked, but they either offer no proof or relate only one or two cases.

No paper has yet been published on the bacteriology of the blood in the milder forms of typhoid fever. Buxton and I²⁸ analyzed the reports of 1602 cases whose blood had been examined bacteriologi-

¹⁸ Soc. méd. d. hôp. d. Paris, 3s, xlii, 669.

²⁰ Arch. d. méd. et pharm. mil., 1897, xxx, 313.

²² Jour. Amer. Med. Assoc., 1898, xxx, 753.

²³ Centralbl. f. Bakt., 1903-04, xxxv, 1 Abt., 776.

²⁴ Quoted by Talayrach, Arch. d. méd. et pharm. mil., 1903, xlii, 393 (unable to find original reference).

²⁵ Jour. Amer. Med. Assoc., 1909, lii, 1903.

²⁶ Arch. de la Direction du service de santé du XIV Corps d'Armée, 1902.

²⁷ Amer. Med., 1901, viii, 639.

²⁸ AMER. JOUR. MED. SCI., 1907, cxxxiii, 896.

¹⁹ Ibid., 1896, 3s., xlii, 698.

²¹ Ibid., 1898, xxxii, 102.

cally, and the only reference we found to the subject was a brief paragraph by Conradi²⁹ stating that he had recovered the typhoid bacillus twice from the blood of cases lasting about eight days each.

THE BELLEVUE HOSPITAL CASES. We do not see many of the milder forms of any disease in Bellevue Hospital. Nevertheless, in the last five years, exclusive of 1908, 10 per cent. of 229 cases of typhoid fever on the second medical division have been of the short-duration variety. The proportion of mild to severe cases has varied in different years: thus, in 1903 there were only 2 mild cases; in 1904, 11 cases (constituting for that year 25 per cent. of the typhoids); in 1905, 4 cases; in 1906, 5 cases; and in 1907, 2 cases. The febrile period in 9 of the 24 cases lasted about two weeks, in 9 it lasted ten days, in 4 it lasted nine days, and in 2 cases it lasted five and six days respectively. One of the two cases which occurred in 1903, and which lasted nine days, gave *Bacillus coli* in pure culture in the blood, but I think it may with propriety be included here.³⁰ The diagnosis in 20 of the 24 cases is not open to doubt, since it rests either upon a positive serum reaction or upon a positive blood culture. In the remaining 4 cases the diagnosis was made upon clinical evidence, it having been impossible for various reasons to study the cases thoroughly, and it therefore is doubtful.

The serum reaction was negative in 6 cases of the series, but in 2 of these the typhoid bacillus was obtained in pure culture from the blood. In 3 of the negative cases blood cultures were not made. In the remaining negative case a blood culture in broth was also negative.

Blood cultures were taken in 19 of the 24 cases, with a positive result 9 times and a negative result 10 times. In one of the negative cases the blood was not taken until after the temperature had reached normal, and according to our present experience would not be expected to contain the bacilli. The bacillus was not found in the blood in any case of less than nine days' duration. Conradi's bile medium was used in only two of the negative cases, the other negative cases having been studied before this medium was recommended. As we have had about 97 per cent. of positive results with the bile medium in all varieties of typhoid fever, and have been much less successful with broth, we do not feel that the negative cases in which broth was used are entirely reliable.

Symptomatology. The symptoms of short-duration typhoid fever have been so well described by several authors, notably Curschmann,³¹ that I shall not discuss them. The temperature curves (Figs. 1, 2, and 3) will show in a general way the course of several of the Bellevue cases.

²⁹ Deut. med. Woch., 1906, xxxii, 58.

³⁰ AMER. JOUR. MED. SCI., 1909, cxxxvii, 199.

³¹ Nothnagel's Encyclopedia, Typhoid fever.

Diagnosis. If one may judge of the attitude of the medical profession toward short-duration typhoid fever from current literature and text-books, the conclusion must inevitably be reached that these cases are not often recognized.

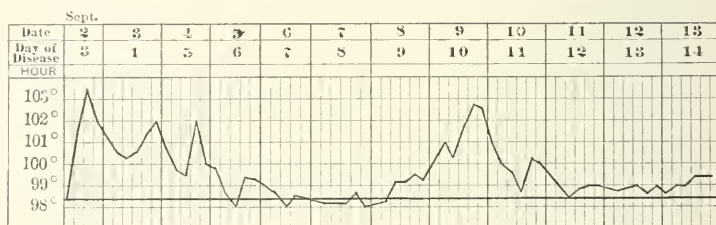


FIG. 1.—Herman R., typhoid fever of seven days' duration, with relapse; positive typhoid serum reaction; blood culture negative.

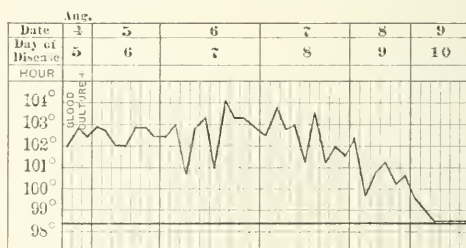


FIG. 2.—Terence B., typhoid fever of ten days' duration; typhoid bacillus obtained from the blood.



FIG. 3.—Dennis C., typhoid fever of fourteen days' duration; typhoid bacillus obtained from the blood.

Reed, Vaughan, and Shakespeare³² state their belief "that the number of cases of typhoid fever among the troops of the — and — Army Corps was more than twice the number recognized as having that disease." And after a discussion of the mortality statistics of typhoid fever in several of the larger cities of the

³² Report of the Commission appointed by the President to investigate the conduct of the War Department in the war with Spain. Washington, 1899, pp. 59, 61.

country, they say:³³ "We are forced to conclude that in these cities a large percentage of the cases of this disease are not recognized as typhoid fever. The army surgeon did in his military service just as he was in the habit of doing in his civil practice, *i. e.*, he failed to properly diagnosticate the milder cases of typhoid fever. His military record is no worse and no better than was his own record in civil practice or is the record of physicians in some of the largest cities of the United States." The sweeping character of this indictment is startling, but the review of the literature forces the admission that it is not overdrawn. Moreover, this review also shows that the failure to recognize the shorter forms of typhoid fever has not been confined to any one country, but has been worldwide.

Lafforgue³⁴ says of short-duration typhoid fever: "The true nature of these forms is not often recognized. They constitute one of the most formidable sources of infection."

Turning to the standard text-books, it is found that all of them contain descriptions of the classical case of typhoid fever, with the usual division of the disease into three periods of a week each. Most of them speak of the abortive cases which begin as the longer cases do. Only one of the American text-books gives more than a passing notice to cases which last less than two weeks. Curschmann gives a classical description of these cases, while Dreschfeld says of them only that during epidemics of typhoid fever, when many mild and abortive cases are about, the differential diagnosis from acute gastrointestinal catarrh may present great difficulty—and leaves the means of overcoming the difficulty to the reader's imagination. The strongest impression conveyed by the text-books is that typhoid fever is a disease of three weeks' duration.

As a final quotation, bearing upon the diagnosis of short-duration typhoid fever, I may cite the title of a paper, by an experienced physician, which appeared in February, 1908. His title is the question, "Is there such a disease as abortive typhoid?" The author believes that there is, but adduces no proof.

When one considers the state of confusion which still exists, according to the published opinions of the leaders of the medical profession, concerning the milder forms of typhoid fever, and also the fact that the study of these cases with the aid of the newer laboratory methods has been largely neglected, it is not surprising that practical physicians should hesitate to make the diagnosis of typhoid fever in a case which shows few of the classical symptoms of the disease and which completes its course in two weeks or less. In a recent conversation with a progressive physician from a town of about 12,000 inhabitants, he said he would be disposed to think

³³ Ibid., page 61.

³⁴ Arch. gén. d. méd., 1905, ii, 2625, 2635.

he had made a mistake in diagnosis if a supposed case of typhoid fever lasted less than two weeks.

But the diagnosis of these cases may easily be made in general practice. It cannot be made clinically except in the presence of some typical complication; one must have recourse to laboratory methods. With dead cultures of the typhoid bacillus, which may be obtained in the market, the serum test may be carried out by any busy practitioner.

Serum Reaction. The fact is well known that a patient's serum may give a positive reaction to the typhoid bacillus when the patient is not suffering from typhoid fever. A positive typhoid reaction means only that the bacillus is growing in the body, and that immune bodies (agglutinins) are forming. Cases of typhoid infection of the biliary passages and typhoid bacillus carriers furnish examples. But if a positive reaction appears transiently during the course of a febrile attack, which is not obviously due to some other cause, the diagnosis of typhoid fever is reasonably certain. It need scarcely be added that to be of value the serum tests must be carefully performed and properly controlled.

The sera of cases of infection by the intermediate members of the typhoid-colon group (the paratyphoid and paracolon bacilli) and by *Bacillus coli* react only exceptionally to the typhoid bacillus, and should be tested against these organisms. So far as is known at present, however, cases caused by these bacilli constitute but a small proportion of the total typhoids, and except in special instances may be left out of consideration. But it must not be forgotten that epidemics of typhoid fever have been caused by the paratyphoid bacilli (Friedel,³⁵ Lempke, Schottelius,³⁶ Kutscher³⁷).

Negative serum reactions possess no diagnostic value unless they are obtained daily throughout the febrile period of the disease and well into convalescence. In some of the Bellevue Hospital cases agglutinins were present in the blood for only one or two days, and if the reactions had not been tested on those days the results might have been considered negative throughout.

Bacteriological Examination of the Blood. Bacteriological examinations of the blood cannot be made unless one has access to a well-equipped laboratory, and therefore will not be of much assistance in diagnosis to the general practitioner. However, the method has served the useful purpose of setting at rest all doubt concerning the occurrence of short-duration typhoid fever. According to our experience at Bellevue, the typhoid bacillus is not found in the blood as uniformly in the short-duration cases as in the longer and severer forms of the disease. In several instances as many as three examinations of the blood gave negative results. Positive bacterio-

³⁵ Zschr. f. Med-Beaunte, 1905, xviii, 306.

³⁶ Münch. med. Woch., 1905, lii, 2116.

³⁷ Ztschr. f. Hyg. u. Infktskrankh., 1906, lv, 331.

logical examinations of the stools and urine do not necessarily prove that the patients have or have had typhoid fever. Brown³⁸ has reported a case of cystitis, caused by the typhoid bacillus, in a patient without a history of typhoid fever. And bacilli of the typhoid-colon group are not infrequently found in the stools of healthy persons—witness the bacillus carriers.

In conclusion, I would say: This study has proved in an incontestible manner that some, at least, of the fevers which formerly would have been considered febricula or simple continued fever are in reality typhoid fever. In the present state of our knowledge it would be rash to assert that all mild fevers in this latitude, for which no other cause can be found, are typhoid in nature, but I can state that we have had no series of cases of mild fevers in Bellevue Hospital in the last five years which could not be proved to be either typhoid fever or some easily recognized disease, as bronchitis, gastro-intestinal disturbance, etc.

This investigation has also brought out the fact that a great deal of confusion exists in the literature concerning the milder forms of typhoid fever, and emphasizes the urgent need, from the epidemiological standpoint, of a more thorough study of these forms. No statistics have been accumulated, since exact methods of diagnosis have come into general use, to show the relative proportion of the mild to the severe cases of typhoid fever. Doubtful cases should be treated as typhoid fever until the cause of the disease can be found.

I would suggest that unless the writers of text-books on medicine, from which students are taught and to which practitioners turn when in doubt, devote more attention to the consideration of the milder forms of typhoid fever, they cannot hope to escape responsibility for a large share of blame for the occurrence of epidemics arising from this source.

Finally, I wish to express my indebtedness and my thanks to Dr. Buxton for making the blood cultures and to Dr. Hastings for performing the serum tests.

HEART FAILURE IN INFECTIOUS DISEASES: ITS PREVENTION AND SUCCESSFUL MANAGEMENT.

BY W. PARKER WORSTER, A.M., M.D.,
OF NEW YORK.

THOROUGHLY to understand the management of infectious fever it is necessary that we understand what is blood pressure, the cause of its enfeebleness, and the proper method to be adopted for its

³⁸ Johns Hopkins Hosp. Rep., 1901-02, x, 11.

control. Blood pressure is a misnomer. The blood does not press upon anything: it is the blood being pressed upon by the three chief blood pressures: (1) The pressure behind the column, the force of the heart; (2) the pressure on the sides of the column, the normal contraction of the muscular fibers of the arteries, and the elastic fibers of the arterioles; and (3) the resistance at the head of the column, the normal elasticity of the capillary bloodvessels. These pressures are maintained wholly by the nerve centres in the medulla oblongata and are enfeebled according to the intensity of the infection and the toxic effects upon those centres. If one of these pressures is relaxed a relaxation of the other two occurs.

Heart failure, that demon whom every intelligent and painstaking physician fears, stands by the bedside of every patient suffering from infectious fever. This enfeebleness of the heart arises from a relaxation of the vasomotor nerve centres by reason of which the capillary vessels lose their elasticity and normal tone. Winternitz has demonstrated in the circulation of the frog that loss of tone and diminution of tension of the capillary vessels enfeebles the action of the heart. Loss of tone then and diminished tension are the cause of heart failure. In infectious fever the danger lies not in the heart but in the toxemia which is spending its full force upon the nerve centres and thus impairing the functions of the organs dependent upon them. Cardiac action, secretions, and nutritional processes are all being crushed by the octopus infection, but the cold bath comes to the rescue, or any form of application of water, according to the indications of the case, when properly applied. The nervous system is refreshed, the eye brightens, the mind clears up, the inspiration deepens, the pulse is slowed and rendered less dicrotic. I distinctly remember two cases of my early days of practice, one of diphtheria, in a child aged thirteen years, and one of typhoid fever, in a subject aged thirty-five years, that were getting well, as I thought; the temperature was normal and the pulse about normal but weak, and both patients were bright; both of them died very suddenly of paralysis of the heart. These were prior to 1889. During that year I took up the study of hydrotherapy in its every phase.

The treatment of the aforementioned cases was by the expectant plan, a term well named, for always something was expected to happen which the physician was powerless to avert. As Dr. Beverley Robinson¹ has justly said, "No organ of the body more frequently requires our wisest government than the heart;" but I would like to add on that point, no organ obeys better than the heart when ordered to do so by the proper authority. An employee who would not obey the command of another employee (strychnine, nitroglycerin, strophanthus, alcohol, digitalis, musk, or other drugs) will obey the command of the boss when he has been reported as negli-

¹ AMER. JOUR. MED. SCI., 1908, cxxxvi

gent of duty. The employee who is ordered in this instance is the heart, and the boss is the central nervous system which controls it and whips it into proper service by means of cold applied to the peripheral nerve terminals. A patient desperately ill with low muttering delirium, unconscious of her surroundings, jactitation, and continually rolling around the bed, whom I saw lately, was completely restored to health by the "general ablution" which I have so often described. This patient's mind was a perfect blank, she did not know her own immediate relatives, nor when her daughter carried her in her arms to the bath tub for three successive days. This patient took "general ablution" at 70° every four hours for about a week, and one "affusion" and one "drip sheet," and was out walking and exercising in the open air inside of ten days.

The excitation of cold is the most valuable, powerful, and reliable stimulant when properly applied, and accomplishes many other important indications. The nerve centres are gently stimulated by the successive gentle shocks of the cold, according to the hydropathic prescription and subsequent reactive stimulus to the sensory fibers of the skin, which is conveyed to the central nervous system and thence reflected to all the functions over which it presides, and upon whose functioning capacity depends the patient's ability to withstand the toxic agents circulating in the blood. In this manner is cardiac action maintained. The several methods of procedure are interesting: for instance, in weakly patients "ablutions" are found most useful. Each part of the body in these cases may be successively bathed, first wrapping the part in a long-haired blanket for one hour, then washing down with water at 88° to 92°, beginning with the higher temperature with good friction, light or coarse, and reducing 2° each ablution to 70°, according to the reactive capacity of the patient, until the whole body has been gone over, chest, back, arms to elbows, and thighs to the knees, with a minimum of disturbance to the patient and a most refreshing effect. This is when the patient is in bed and cannot get up. Dilatation of the capillary vessels always follows friction, which must never be omitted, as it is the *sine qua non* of all applications of cold water. Chilling of the patient and a little chattering may sometimes occur, but there is nothing at all to be feared from it, as these baths generally reduce the temperature 2° or 3°, deepen the breathing, stimulate the heart, and refresh the patient as no remedial agent is capable of doing. In order that its effect be continuous upon the heart it is necessary that the operation be repeated every three hours. The most important effect of these applications is the aid and sustenance they afford the central nervous system, which bears the brunt of the fight, stimulating it to enhance the vital powers of the patient and thus place him on the road to a rapid recovery.

Management of the patient by means of hydrotherapy renders the prognosis of the case entirely different from management by the expectant plan. Recovery by the expectant plan seems to depend

upon circumstances over which the physician has no control; if the patient has the constitution to withstand the toxemia he gets well; if not, he dies; but by hydrotherapy we enhance the patient's vital powers against the lethal agencies evolved in the infection process, thereby spurring on the central nervous system to furnish innervation for respiration, circulation, digestion, tissue building, and excretion, and bridging over the danger which would arise from failure of these functions.

THE SYMPTOMS OF DESCENDING THORACIC ANEURYSM.

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ANEURYSMS of the thoracic arch which reach any considerable size usually produce characteristic signs or symptoms. An abnormal pulsation, murmur, or area of dulness, a tracheal tug, or a left vocal paralysis immediately direct attention to the possible presence of an aneurysm, and the x-rays are called upon to contribute their important diagnostic aid. When the descending thoracic aorta is involved, however, signs and symptoms are very apt to be lacking, and when present they are frequently misinterpreted. In the cases that we have seen this has occurred almost uniformly. It seems advisable, therefore, to report our cases, calling special attention to the typical pains that have been so graphically described by Huchard.¹ Autopsies were obtained in but two of our six patients, yet the diagnosis in the remainder was made almost certain by the results of x-ray examination.

CASE I.—W. T. H., a stableman, aged forty-two years, was first seen at the Cooper Medical Dispensary, San Francisco, on June 5, 1903, complaining of pain in the left side. The family history was negative. The patient had had the ordinary diseases of childhood, grippe in 1887, and gonorrhœa three or four times. He denied syphilis, but had always chewed tobacco and drank excessively. Since October, 1902, he had suffered from pain in the left side of the thorax, which was worse at night and kept him from sleeping. At times he had slight dyspnoea.

Examination showed a well-nourished man with a face indicative of overindulgence in alcohol. The pupils were equal and reacted normally. Both sides of the chest expanded poorly, but the left distinctly less than the right. The breath sounds were feeble and

¹ *Maladie du cœur et de l'aorte*, ii, 427.

distant, the expiration prolonged. No abnormal dulness or bruit over the back, and no friction sounds were found. The area of cardiac dulness was enlarged moderately to the right and left. The heart sounds were normal in character and intensity. The pulse was 110, equal and synchronous in both wrists. The radial arteries were moderately thickened. There was no tracheal tug.

On account of a distinct tenderness along the course of the fifth and sixth intercostal nerves a diagnosis of intercostal neuralgia was made and the ordinary remedies given. The patient returned occasionally to the dispensary for several months, always with the same complaint of pain in the left side. Repeated examinations by different members of the staff failed to discover any sign that would



FIG. 1.—Skiagram of Case I.

indicate the cause of the pain other than the tenderness over the nerves. After a few months the patient ceased coming to the dispensary.

On March 8, 1905, he returned again, complaining of his old symptoms. Again the examination was negative, except for very definite tender points to the left of the spinal column, in the left axilla, and to the left of the sternum. On account of the severity of his pain, he was sent to the Lane Hospital and was again treated for neuralgia. On April 6, 1905, a routine fluoroscopic examination was made by Dr. Lehmann. His note in part was as follows: "The transparency of the left lung is markedly less than that of the right. In the left side of the thorax there is a large shadow about the size of a child's head, which cannot be differentiated from the shadow of the

aortic arch. This shadow is sharply outlined and apparently shows true pulsation. Viewed from behind, the shadow is more marked, clearer, darker, and smaller than when viewed from the front. The heart is in a pronounced horizontal position. The diaphragm on the right side moves 6 to 7 cm., on the left side only 3 to 4 cm." In view of these findings (Fig. 1), a diagnosis of aneurysm of the descending thoracic aorta was made. Two days later the patient began to cough up blood, and died within a few minutes.

The autopsy, performed by Dr. Ophüls, showed the heart to be normal. There was marked atheroma with many white retracted scars and moderate dilatation of the proximal portion of the aorta; less dilatation of the arch. At the distal end of the arch posteriorly a round opening about 4 cm. in diameter lead into an aneurysmal sac about the size of an apple. The aneurysm extended posteriorly and to the left, and had deeply eroded the spinal column. The aneurysm was adherent to the left lung, and had perforated into the upper posterior part of the lower lobe, which showed hemorrhagic infiltration. The lower thoracic and abdominal aorta showed very little atheroma.

CASE II.—C. W., aged sixty-one years, a veteran, came to the Cooper Medical Dispensary on January 3, 1908, complaining of stomach trouble. The family history was unimportant. The patient had always been strong and healthy. He had had jaundice in 1880, pneumonia in 1890, and a hard chancre about 1890, not followed by secondaries. He was treated with mercury and potassium iodide. He had had several attacks of gonorrhœa. He never drank excessively. His present illness had begun five or six months before with a boring pain in the back. This pain had been more or less continuous and had often prevented his sleeping. About six months ago his stomach had begun to give him trouble for the first time. He suffered from epigastric pain, which seemed to be made worse by eating. He had vomited occasionally, but never vomited blood or material eaten on previous days. There was no difficulty in swallowing, and no jaundice, cough, or headache. There was slight dyspnoea on exertion. He was very constipated. He had lost 70 pounds in six months, and was very weak.

Examination showed an emaciated, pale, old man. The pupils were equal and reacted normally. The lungs were negative. There was moderate dilatation of the cutaneous veins across the upper left front of the thorax and left shoulder. Careful examination posteriorly and anteriorly failed to show any definite abnormal pulsation, dullness, or bruit. There was no tracheal tug. The heart was negative. The liver was slightly enlarged and palpable. There were no enlarged glands. Inflation of the stomach showed no dilatation. No abdominal tumor was felt either externally or by the rectum. The urine was negative. The blood showed a marked secondary anemia: red corpuscles, 3,750,000; hemoglobin, 66 per cent.; leuko-

cytes, 8000, with a normal differential count. The stomach analysis showed an absence of free hydrochloric and of lactic acids; total acidity, 10; no retention of raisins taken the night before.

In this patient the recent onset of serious stomach trouble at the age of sixty-one, the rapid loss of weight, the secondary anemia, and the results of the stomach analysis led us to suspect a gastric carcinoma. The thoracic pain and the dilatation of the veins over the upper left chest and shoulder aroused a strong suspicion of metastases into the posterior mediastinum. An *x*-ray plate was therefore taken. Though rather poor and taken too low down, this sufficed to show a uniform round shadow above and to the left of the heart shadow (Fig. 2), characteristics which in connection with the



FIG. 2.—Skiagram of Case II.

symptoms led us to a diagnosis of an aneurysm of the descending thoracic aortic. As the patient left the city immediately after his exposure to the *x*-rays, it was not possible to reëxamine him. He died on January 27, 1908. The autopsy, performed at the Veterans' Home, Yountville, by Dr. A. H. Reinstein, showed that the cause of death was the rupture of an aneurysm of the descending thoracic aorta into the left pleural cavity. A carcinoma of the pylorus with metastases in the posterior lymphatic glands were also found.

CASE III.—C. A. B., aged fifty-one years, a paper hanger and decorator, entered the Lane Hospital on January 27, 1908, complaining of pain under the lower left scapula and in the epigastrium. The family history was negative except for the death of two brothers of tuberculosis. He had always been strong and healthy, never having

had any of the acute infectious diseases since childhood. He had been a periodic drinker and had smoked excessively. He had gonorrhœa once. At twenty-one years he had what appears to have been a soft chancre without secondaries. The present trouble had begun about a year before, with constipation and dyspepsia. This had lasted a few weeks, then disappeared for a few months, and recurred for a few weeks. Three months ago the dyspepsia, constipation, and pain in the epigastrium had re-appeared, and have been present more or less continuously up to the time of admission. The pain had gradually grown worse. It was most marked in the epigastrium, but sometimes extended through to the left back. When the pain was severe the epigastrium was rather tender and felt drawn, as if a



FIG. 3.—Skiagram of Case III.

lump were present there. At times the pain was accompanied by belching of gas. The pain showed no definite association with the taking of food. It was most marked when the patient lay down or when he sat too long in one position. It was most severe at night, and often wakened him out of a sound sleep.

Examination showed a well-developed but rather poorly nourished man. The pupils were equal and reacted normally. The lungs and heart were negative. There were no normal pulsations, no dulness, and no bruit over the back. Both sides of the chest moved symmetrically. Abdominal examination was negative, except for a slight rigidity of the upper left rectus muscle, which became more marked when the pain was severe. The urine and blood were normal. Repeated examinations of the feces for occult blood were negative.

Two stomach analyses gave approximately identical results: 60 c.c. of yellowish mucoid material, containing bits of undigested bread; total acidity, 1S; no free HCl, no lactic acid, no occult blood, no retention of raisins taken the night before.

The pains were not relieved to any appreciable degree by careful dieting and the administration of acid. During his stay in the hospital they gradually became more severe, especially posteriorly at about the level of the tenth dorsal spine. The only circumstance which seemed to influence them definitely was posture. Whenever he lay on his back or left side the pains became worse. For this reason he usually slept lying face downward. Considerable tenderness to deep pressure was discovered over the eighth to eleventh dorsal spines. A zone of hyperalgesia to the scratch of a pin was found on the left side corresponding to about the distribution of the ninth and tenth dorsal nerves. This hyperalgesia was much more marked behind than in front. On account of the hyperalgesia and the effect of posture upon the pains, an *x*-ray plate was taken of the lower thorax (Fig. 3). This showed an abnormal shadow behind the heart apparently continuous with the shadow of the descending thoracic aorta. Dr. C. M. Cooper² agreed with us that the symptoms and *x*-ray examination taken together indicated that the patient was suffering from an aneurysm of the descending thoracic aorta.

CASE IV.—O. K., aged thirty-eight years, a butcher, came to the Cooper Medical Dispensary on March 23, 1905, complaining of pain over the heart and between the shoulders. The family history was negative. While serving in the German army, at sixteen years he contracted gonorrhœa and at the same time had a chancre, followed by definite secondaries. He was treated with inunctions. He had been a hard drinker and a moderate user of alcohol. His present illness had begun three months before with pain over the heart and between the shoulders. These pains were very intense. They came on only when he lay on his back or on his left side, and not, as a rule, when he lay on his abdomen or right side. The pain was not influenced by exertion, coughing, or deep respiration. About one-half hour after lying down, he would be awakened by the pain, and relief could only be obtained by sitting up for a few minutes. If he again lay on his back, the pain invariably returned. He had had slight dyspnœa for fifteen years. There was no swelling of the feet, no cough, and no loss of the voice; appetite was good; the bowels were regular.

Examination showed a well-nourished and healthy-looking, though somewhat nervous, man. The pupils were equal and reacted normally. An indefinite tracheal tug could be felt when he lay recumbent and held a deep breath. The left side of the chest moved decidedly less than the right. There was no definite dulness, respira-

² We are indebted to Dr. Cooper for this plate, as well as those of Cases II and IV.

tory changes, or bruit over the back. The heart was negative, except for a moderate accentuation of the second aortic sound. The radial arteries were moderately thickened. There was no tenderness over the dorsal spines. An area of hyperalgesia to the pin scratch could be easily demonstrated to the left of the vertebral column, extending in a vertical direction from about the fourth to the eighth dorsal spines and laterally as a band around the left side of the chest (Fig. 4). This hyperalgesia was much more marked behind. In front it became narrower and less definite in outline. On account of the history of syphilis, the accentuation of the second aortic sound, the area of hyperalgesia, and the character of the pain, a probable diagnosis of aneurysm of the descending thoracic aorta was made. This was confirmed by fluoroscopic examination, which showed a large pulsating shadow to the left of the spine, more distinct when viewed

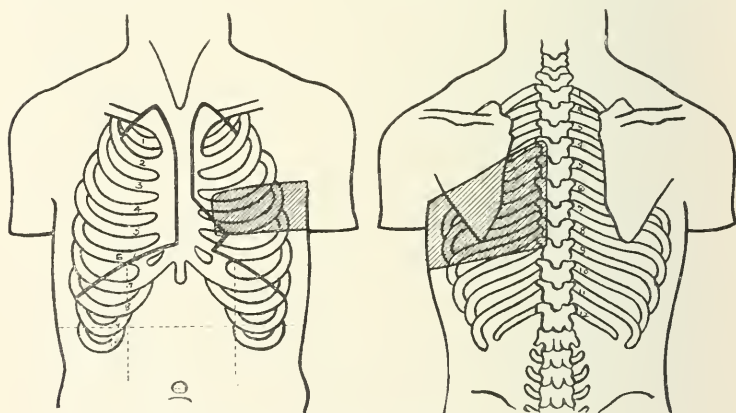


FIG. 4.—Hyperalgesic zone in Case IV.

from behind than when viewed from the front, and plainly located in the back of the chest when the patient stood in an oblique position (Fig. 5). An aneurysm of the descending thoracic arch was, therefore, the cause of this patient's pain.

CASE V.—J. G., aged forty-one years, entered the medical ward of the University of Michigan Hospital on October 10, 1908, complaining of shortness of breath and of constant pain in the left side of the abdomen and back. The family history and past history were negative. He denied alcoholic excesses and venereal infection. The present trouble began about three years before with sharp pains in the left side, which lasted three days and were relieved by a lotion. After a couple of weeks the pains again returned and were again relieved by rubbing. These pains had continued off and on and with varying intensity since then. About a year before they had been so severe that he could not sleep for six weeks. They had been diagnosed

as pleurisy and intercostal neuralgia. He had also been moderately short of breath on exertion, and at times had suffered from palpitation.

In the ward the patient was usually found on his left side, which position afforded him relative relief from his pains. His pupils were equal and reacted well on accommodation, but not to light. There was no tracheal tug. The left chest lagged on inspiration, especially in its lower part. There was some impairment of resonance over the left lower chest behind, from about the sixth spine down, accompanied by diminished breath sounds. Indefinite systolic pulsation was noted on some occasions just to the left of the eighth spine. Below this a fair Broadbent sign could be seen at times. Over the area of pulsation the heart sounds were heard exceptionally well, but there were no murmurs.

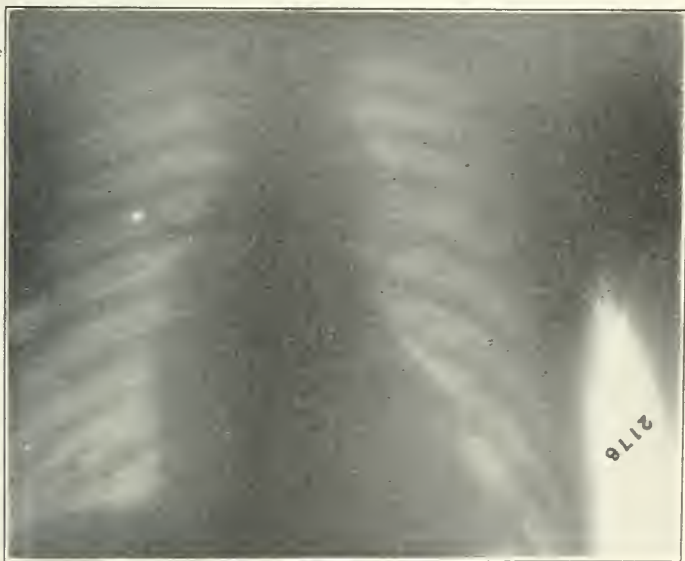


FIG. 5.—Skiagram of Case IV.

The apex beat was rather diffuse, but could be distinctly felt as far as 14.5 cm. to the left of the median line in the fifth intercostal space. In the recumbent posture a systolic thrill was felt in the third left intercostal space. The area of cardiac flatness was decidedly enlarged, extending from the middle of the sternum to within 1 cm. of the left mammary line. It joined the liver flatness by an obtuse angle. The area of cardiac dulness extended 15 cm. to the left of the median line and 5 cm. to the right. It was continuous above with a broad area of dulness, which extended upward on either side of the sternum to the clavicle. At the apex one heard a slight blowing systolic murmur and an indefinite diastolic rumble, the latter being sharply limited to the region of the apex beat. Toward the sternum

the systolic murmur became louder, reaching its maximum in the third intercostal space 5.5 cm. from the median line. Here it was an exceedingly rough and intense murmur. This murmur was transmitted over the left chest upward as far as the second rib and outward as far as the anterior axillary line. It was barely heard beyond the right border of the sternum and not heard in the vessels of the neck. It was faintly heard over the left back opposite the second dorsal spine. In front the murmur became less loud during deep inspiration and when the patient sat up. It varied in intensity from time to time, but, on the whole, was very constant. The pulmonary second sound was accentuated and at times could be felt as a distinct shock. The knee-jerks and ankle-jerks were absent. The urine and blood were negative.

One of the most striking features of the patient's examination was the zone of disturbed sensation which extended around the left side

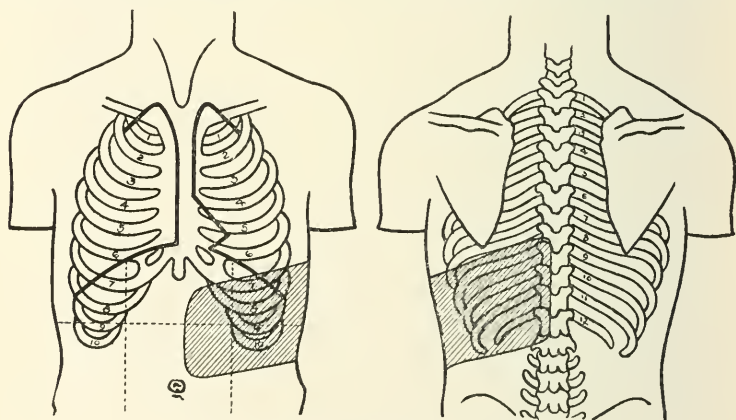


FIG. 6.—Hyperalgesic zone in Case V.

from the spine to the median line in front. It varied in width, but was most constant between the levels of the eighth and twelfth dorsal spines behind and the ensiform and umbilicus in front (Fig. 6). At first there was everywhere extreme hyperalgesia to the pin scratch and to pressure, but later the anterior portion of the zone showed anesthesia to the touch of the camel's-hair brush and was associated with hyperalgesia to the pin scratch. On November 29 a slight weakness of the upper left rectus muscle was noted, but this later became less marked.

During his stay in the hospital the patient suffered more or less continuously from pain in the left side. When this was severe he always lay on this side, other positions being impossible on account of pain. When the pain was less severe he occasionally walked about the ward, but one gained the impression that such exertions were often succeeded by renewed exacerbations of the pain.



FIG. 7.—Skiagraph of Case V taken in a sagittal direction.



FIG 8.—Skiagraph of Case V taken from the oblique position; it shows the left aneurysmal border distinct from the heart,

The x -ray examination showed an abnormal shadow behind the heart. If the patient, facing the fluoroscopic screen, were rotated to the right, this abnormal shadow could be seen moving to his left while the heart moved to his right, thus demonstrating its position behind the heart. Plates taken from two directions (Figs. 7 and 8) illustrate this. The smooth rounded outline of this posterior shadow, together with some pulsation, indicated that it was caused by an aneurysm of the descending thoracic aorta situated behind the heart. The crowding of the heart forward undoubtedly accounted for some of the abnormal cardiac signs and rendered it difficult to determine



FIG. 9. —Skiagram of Case VI.

just what other factors came into play, though probably the loud systolic murmur over the pulmonary area was due to a partial obstruction of the pulmonary artery or its left branch. The patient had *tabes dorsalis*, and one might question whether his pains and disturbed sensation were due to the aneurysm or to the *tabes*. As the site of these nervous disturbances corresponded to that of the aneurysm, it seems probable that the latter was their cause.

CASE VI.—W. B., aged sixty-four years, had entered the medical ward of the University of Michigan Hospital on several occasions suffering from arteriosclerosis, dilated heart, and chronic nephritis. He had the ordinary symptoms of broken compensation together

with Cheyne-Stokes breathing. The discovery of his aneurysm was purely accidental. A plate taken to determine the heart outlines showed a rounded shadow which arose from the middle shadow at the upper level of the aortic arch and described an arc well outside the left sternal margin until it intersected the heart shadow (Fig. 9). Fluoroscopic examination of this abnormal shadow showed that it pulsated, and by rotating the patient on a revolving stool, that it was situated in the posterior portion of the chest. It was more clearly seen from behind than from in front. The patient showed no deformity of his chest. We must conclude that this was a fusiform aneurysm of the descending thoracic aorta. Apparently it produced no symptoms whatever. Neither could signs be found which were definitely referable to the aneurysm, with the possible exception of bronchovesicular breathing in the left axilla. This might have been due to compression of the lung.

A review of these six cases of descending thoracic aneurysm allows us to divide them roughly into two groups. In the first, which is represented by the first five cases, the main symptom was pain; in the second group, represented by the last case, no symptoms whatever were present. There are numerous instances in the literature of the accidental discovery of unsuspected aneurysms. This occurred in 5 per cent. of the 104 aneurysms reported by Baetjer.³ It happens so frequently when the aneurysm arises from the descending thoracic aorta that Huchard⁴ speaks of this as the zone latente des aneurysmes meconnus, des erreurs de diagnostic. Such aneurysms may reach a large size without giving rise to any symptoms previous to their final rupture into the lung, bronchus, esophagus, pleural cavity, or mediastinum.

The remaining five cases may be grouped together, the main symptom being pain. In our patients this pain, though varying from time to time, was, on the whole, of extraordinary severity. Its situation in the individual patient was practically constant, and it was remarkably resistant to all forms of medication. In one patient the pain was of a dull, boring character and located in the centre of the back. In the other four it was limited to the left side of the thorax and was of a neuralgic type, with either typical tender spots or a zone of cutaneous hyperalgesia. The latter was present in three patients, and in one of these (Case V) it was associated at times with anesthesia to the touch of the camel's-hair brush. Such a dissociated sensory disturbance caused by the pressure of an aneurysm upon the intercostal nerves has been described in detail by Frick.⁵ In one of our

³ The X-ray Diagnosis of Thoracic Aneurysms, Johns Hopkins Hospital Bulletin, 1906, xvii, 24.

⁴ Loc cit, p. 413.

⁵ Ueber objective nachweisbare Sensibilitätsstörungen am Rumpfe bei Aneurysma Aortæ, Wien. klin. Woch., 1901, No. 25.

patients there was a spasm of the upper left rectus muscle, which increased when the pains were severe; in another there was at times a paresis of this muscle. In all the cases of this group the pain showed pronounced nocturnal exacerbations. In three this was a distinctly postural effect, for the pain was accentuated when the patient lay on his back. One patient slept on his face, another on his left side, while a third had to sit up in order to be relieved of the pain. In two of our patients the main pain was referred to the front of the body; in Case IV, to the heart, simulating angina pectoris, and in Case III, to the upper abdomen. Such referred pain may lead to the mistaken assumption that a viscus is diseased and that the tenderness or hyperalgesia behind is a Head's area. Thus, in Case III, with epigastric pain, spasm of the left rectus muscle, and tenderness behind, it was at first believed that the pain originated in the upper abdomen. This patient had been sent into the hospital for an exploratory operation, which might have been performed in the attempt to locate the pain had not the x -ray examination demonstrated an inoperable condition. Similar pseudogastric pains have been noted by others (Rendu⁶); and Baetjer recites a somewhat analogous history of a patient in whom a gallstone operation had actually been performed with negative findings three years before the x -rays finally showed that a large aneurysm of the descending thoracic aorta was the cause of symptoms. Milanoff⁷ found histories of three patients who had been treated for renal colic. These abdominal pains are particularly apt to be caused by aneurysms situated just above the diaphragm. They are common enough also in abdominal aneurysms. A patient recently sent into the Lane Hospital was supposed to be suffering from biliary colic or a duodenal ulcer, but the exploratory operation showed an aneurysm of the upper abdominal aorta.

The neuralgic pains present in four of our patients were evidently due to some damage to the intercostal nerves. Whether they were due to pressure alone or, as many clinicians believe, to a chronic inflammation in the neighborhood of the aneurysmal sac is difficult to decide. The pain referred to the front of the body, the zones of disturbed sensation, and the spasm or paresis of the muscles evidently could not be accounted for by other factors sometimes held responsible for aneurysmal pains, such as erosions of the bone or disease of the vessel wall.

From our experience pain is the most frequent symptom of descending thoracic aneurysm. Milanoff, who collected the histories of 120 patients with this disease, found pain mentioned in 72 of them, whereas dysphagia occurred in 20, hematemesis in 13, hemoptysis in 21, left pleural effusion in still fewer. Andréef⁸ could collect but 8

⁶ Cited by Milanoff.

⁷ *Etude de la douleur et de quelques autres symptômes des anévrismes de l'aorte thoracique descendante*, Thèse de Paris, 1900.

⁸ *Contribution à l'étude des anévrismes de l'aorte descendante*, Thèse, Toulouse, 1904.

cases of paraplegia from this cause. When one remembers that most of these symptoms, with the exception of pain, occur late in the disease, the great importance of pain as an early symptom of descending thoracic aneurysm becomes apparent. In some instances it has lasted ten or even twenty years.

The physical signs of aneurysm of the descending thoracic aorta are of such an indefinite character that only exceptionally can one make a diagnosis from signs alone previous to erosion of the bony thorax. In none of our patients was a murmur heard over the site of the aneurysm, though listened for in every case. In Case V, in which a large aneurysm was situated directly behind the heart, the heart sounds were heard with unusual distinctness over the site of the aneurysm. Slight pulsation with some dulness over the left back were also found in this patient; in the remainder all these signs were absent. Two patients showed indications of pulmonary compression, diminished breath sounds in one and bronchovesicular breathing in the other, but as both had large hearts it was difficult to be certain that the aneurysm was the sole cause of the signs. In three patients a diminished mobility of the left side of the thorax was noted, and in one of these a lessened excursion of the left side of the diaphragm was seen with the fluoroscope. In two patients there was sensitiveness of the dorsal spines, and in three a zone of disturbed sensation around the left side of the body.

The great value of *x*-ray examinations is apparent in such cases as these. One is often astounded to see the size of the aneurysm that has escaped detection by the ordinary methods of physical examination. The difficulties encountered in the interpretation of *x*-ray findings⁹ are certainly negligible compared with the difficulties surrounding the use of ordinary methods of diagnosis.

As a result of our experience with aneurysms of the descending thoracic aorta we cannot do better than quote the words of Huchard when he speaks of aneurysmal neuralgias: "When one is dealing with symptoms of pain characterized by their persistency, their long duration, their intensity, when they remain unexplained, when they resist all ordinary medication, finally, when they present certain special characteristics, such as a fixed location or a diminished severity in certain attitudes of the patient, then we are not dealing with true neuralgia, as is too frequently assumed. In such cases one should consider aneurysm as a probable diagnosis, and if no tumor is perceptible as yet, one should turn to the *x*-rays in order to obtain certain proof."

⁹ Sewall and Childs, *The Interpretation of X-ray Pictures as an Aid to the Early Diagnosis of Thoracic Aneurysm*, AMER. JOUR. MED. SCI., 1907, cxxxiv, 360.

THE REVERSION THEORY AND CLASSIFICATION OF GOITRE.

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I.

IN making a daily study of goitre, grossly and microscopically, in the fresh and fixed condition, after examining specimens from 700 cases with their histories, and after reviewing the literature which recently has become extensive, I have been struck by the variance of the opinions and also the variance in the methods of attack in the study of the etiology.

The symptomatology seems, at least in well-developed cases, to be clearly known, and is well summarized in recent articles, such as those of Barker, Kocher, Halsted, Mayo, and others. I feel that there are early cases which are not diagnosed as soon as they should be, because the symptoms are not associated with noticeable external glandular enlargement; it behooves the examining physician, therefore, to consider the possibility of hyperthyroidism in all cases of tachycardia and extreme nervousness. Such a diagnosis, however, does not mean surgical treatment always, although it is often in these early cases that complete recovery is seen following operation.

Briefly it may be stated that the etiology of hyperthyroidism is still far from being satisfactorily explained. Before beginning the study of goitre, we must first consider the normal biology of glands in general and of the normal thyroid.

If we review briefly the anatomy and function of the normal epithelial glands, such as the breast, salivary glands, and the pancreas or the liver, we find that all these start embryologically as invaginations, either of the endoderm or the ectoderm, and that the anatomical and the histological unit of these glands, with the exception of the liver, is an alveolus lined by one layer of epithelium, which hypertrophies and secretes into the alveolus. It may be further noticed that the secretion of each gland has one or more definite functions (nutritive, excretive, or protective) which are stimulated to activity either by the senses, sight, smell, taste, hearing, or touch, the sensations of which are transmitted through the nerves, or by some chemical substance¹ put into the circulation by some other cells in another

¹ See the work of Dolinsky (1895), who discovered that acids brought in contact with the mucous membrane of the duodenum set up promptly secretion of the pancreatic juice. This action was supposed to be reflexly through the nerves, but since the work of Popielski, Bayliss, and Starling, which shows that this action takes place after the nerves are severed, some other explanation has been thought of. They determined that if an extract of the mucosa of the duodenum and 0.4 per cent. HCl were made and injected into the blood, pancreatic secretion would be set up. The especial substance formed by this mixture they have called "secretin," and Starling has referred to it as a "messenger" from the duodenum through the blood to the pancreas. Howell's Text-book of Physiology, p. 703, and Bayliss and Starling, *Journal of Physiology*, 1902, xxviii, 325.

part of the body, or by both of these means. The epithelial glands which open into the alimentary tract either directly or by ducts, as do the buccal, salivary, gastric, intestinal, hepatic, and pancreatic, have one or more of the following functions; the production of a diluent, a mucilaginous material and ferments, or at least some digestive substance.

The thyroid is an epithelial gland conforming to the above anatomical conditions with the exception that it does not in its present condition possess a duct into the alimentary canal. We are, however, justified in believing that it probably did, at one time in the development of man, open into the canal by a duct, since most surgeons of extensive experience have operated on cysts of the thyroglossal duct, which has its origin in the gland and its opening in the foramen cæcum. Anatomically the thyroid is a well-defined gland, histologically not unlike some other epithelial glands, located near the alimentary canal, and showing at times remains of a duct emptying into it.

If such a gland emptied its contents into the alimentary tract, the contents probably had one or more of the above-mentioned functions of glands, as it is hardly conceivable from any known facts about any other glands similarly situated, that one so located would be without such a function. When, in the periods of man's phylogenetic history, he has been put under an environment which lacked the normal stimulus² necessary for the continuance of such an organ is not known. There was, however, a period in his racial development when this gland had a more extensive function.

This I believe to be a fair assumption from its anatomy and the facts known regarding the gradual disappearance or diminution in function of other organs, such as the loss of function in the male breast, diminution of the function of the toes, loss of body hair, and loss of function of the appendix. Other examples may be perhaps found in the economy of the organism.

With such facts and suppositions before us, and having some knowledge of the process of reversion, as seen in organs, in plant and animal life including man, especially the latter, in whom we see secreting male breasts, secreting supernumerary breasts, polymastia, bicornate uteri, etc., it is not unnatural to think of the possible partially rudimentary thyroid as reverting to its original activity.

In case this ductless gland should revert to a more extensive activity, what would occur in it? The first evidence would probably be hypertrophy and secretion. If this occurred, two things are possible: Either there would be a cyst formation, or absorption of the products produced. These two possibilities are often seen in other organs: for example, in the liver and kidneys under obstructive

² In calling this a normal stimulus, liberty is taken from a knowledge of the action of all the other epithelial glands in the human body as it exists now. These glands are stimulated to activity normally by certain substances under certain conditions.

conditions. In the liver the backing up of the secretion causes dilatation of the ducts, enlargement of the liver, but seldom cyst formation. The secretion under such pressure is supposed to get into the lymphatics and thus into the circulation, giving evidence of this in jaundice and toxemia.

In the kidney a similar process is seen, with perhaps a greater tendency to the production of cysts. However, here, too, we see both conditions in which there is also re-absorption of the products of secretion and resulting toxemia. Why the cyst formation should occur in one instance and not in another is not known.

These processes in the kidney and liver and other glands are very similar to those seen in the "simple cystic" goitre and the "exophthalmic" goitre. In the former case the alveoli are markedly distended and contain products, the pressure of which flatten the epithelial lining and in some cases produce complete atrophy of the cells, so that the whole thyroid exists as a foreign body composed of cysts and only causing inconvenience by pressure. When, however, there is complete atrophy of the secreting surface a condition of myxœdema may occur, as we shall see later. Early in the case of "exophthalmic" goitre the material secreted is not stored in the alveoli, but is re-absorbed, and it is in these cases especially that the toxemia is seen, although toxemia does occur, as we shall see later, in some cystic goitres under certain conditions (Fig. 5 *a* and *b*).

Like the absorbed products of the kidney and the liver, the products of the thyroid produce toxic symptoms and even death, with the changes seen at autopsy which occur in other toxemias. The liver is fatty, there may be changes in the kidneys, the heart is often fatty and markedly dilated.

The clinical picture is one of toxemia with mental, nervous, and digestive disturbances. The substance or substances which produce this toxemia are the products of the thyroid, since their associated iodine has been demonstrated in the blood of patients suffering from hyperthyroidism. Similar symptoms can be produced experimentally by the overfeeding of the products of the thyroid. Removal of the greater portion of the secreting gland reduces the symptoms and often causes them completely to disappear. We must, therefore, consider the toxin, so to speak, as being the product of the gland itself, just as the toxic substances in the cases of the kidney and liver are products of their own secretion.

In the case of the thyroid, however, a certain amount of the secretion is apparently necessary for the well-being of the individual, because we see death following total extirpation of the gland. These cases go on to a condition of myxœdema which can be relieved by feeding the products of the gland.

In the condition of cretinism, in which there is an absence of thyroid secretion and a concomitant physical underdevelopment, great improvement may be seen after thyroid feeding. All of these

examples seem to demonstrate the possible physiological necessity of the products of the thyroid. The contrast between a patient with hyperthyroidism and one with hypothyroidism is very marked, the conditions being clinically quite opposite, in that one is the subject of extreme activity, while the other is the subject of extreme apathy or sluggishness. The necessity of the thyroid for the economic equilibrium has two possibilities for its solution. Either the products normally secreted are re-absorbed, or there is an "internal" secretion. The whole problem of internal secretion is one about which we are not so absolutely certain, unless we give it a very broad meaning in that each organ really contributes something to the body fluids which is characteristic of itself. This is perhaps a correct one in view of the results obtained from the studies of immunity. It must not be forgotten that the internal secretion may be twofold, as that in the liver in which one product is for nutrition (glycogen) and the other for elimination (urea).

It may be stated that at present we are beginning to look upon the different types of goitre as stages in one general process. This is seen histologically in the type known as "exophthalmic goitre" (Fig. 4), which histologically is an exaggerated picture of the process of papillary projection formation (Fig. 5 *b*) found in some of our "colloid" goitres, which give "exophthalmic" symptoms. This is so true that in the routine examination of sections from different areas I have, for want of any definite name, in some cases written my report "colloid goitre with exophthalmic areas," or "colloid, foetal, and exophthalmic goitre," recognizing in these specimens all three types well developed. At times it is possible to demonstrate areas which are absolutely typical "exophthalmic goitre," and in other areas find typical foetal adenoma and typical "colloid" goitre. These findings have led Dr. Wilson and me to believe that the so-called "types of goitre" are not "types" but "stages." Why one thyroid should develop into a cystic or "colloid" goitre and another into an "exophthalmic" goitre is unknown, just as the process of cyst formation and its counterpart, the absorption without cyst formation, in the kidney and liver are unknown.

In view of the fact that the thyroid is an epithelial gland, producing a secretion which seems necessary for the body economy, and that this secretion was most probably emptied into the alimentary canal through a duct, the question of the normal stimulation of this activity naturally presents itself, since we know that all the other epithelial glands act as a result of some type of physiological stimulus.

The question arises: What was the normal stimulus for the thyroid under its original conditions, and would the same thing stimulate it again to activity under a condition of reversion, as we see it in the supernumerary breasts? I have recently had a case of a woman, who was brought to the clinic with a diagnosis of lipomas in the axillæ, which when removed proved to be functioning supernumerary

breasts without ducts, there being absolutely no sign of nipples. These tumors appeared at puberty and had recently become markedly hypertrophied during pregnancy. We have in this case breasts which are rudimentary and ductless, stimulated to activity by the natural stimulus for the natural breast activity. The patient was otherwise normal. The breasts upon microscopic examination presented the picture of normal breasts with the exception that the acini were markedly dilated or cystic, and contained a somewhat thickened milk. The interglandular tissue, especially that immediately surrounding the alveoli, was infiltrated with lymphocytes.³ It is these facts and the analogy of the thyroid to other glands and their activities which led me to the reversion hypothesis for the condition known as goitre, without attempting to state the real etiological stimulus.

May the process known as goitre be expressed as an attempted reversion of the thyroid to its original function, being stimulated to activity by the same substance which stimulated it to activity in primitive man? What this stimulating substance is, where it is found, and how it stimulates the gland to activity is unknown.⁴ Whether this factor is organic or inorganic, living or dead, is left to the etiologists. In presenting such a theory it seems to me that it may stimulate further investigation, not only among medical men, but among biologists generally.

The physiological chemist has a great field before him in determining the source in the intestinal contents, either as a substance taken into the tract or as a result of breaking down or synthesis of organic or inorganic substances. He may also busy himself with the products of metabolism found in the fluids of the body which may contain the substance or living thing which causes the hypersecretion of the organ. Perhaps such an hypothesis may open a new field of research; it is with this view that I have taken the liberty of publicly expressing it.

³ Often associated with the process of absorption is seen a round-cell infiltration. This condition in goitre has led many to conceive of an etiological process of an infectious nature. This round-cell infiltration has been found in thyroids of individuals who have given no history of having any symptoms of hyperthyroidism or enlargement of the gland, although I may suggest that perhaps a great many individuals undergo some symptoms of hyperthyroidism unnoticed and perhaps unrecognizable in the thyroid microscopically.

⁴ The stimulation of glandular activity, while it is not clear in most cases, shows itself dependent upon normal conditions. The mammary glands, for example, are stimulated to hypertrophy and secretion during pregnancy by some influence started in the female pelvic viscera. What this is or how it acts is unknown. The glands of the stomach are stimulated to activity by the sensation of eating (psychical), by stimuli in the mouth and nostrils. It seems (Howell's Text-book of Physiology) that some foods contain substances capable of effecting the secretion, and that "meat extracts, meat juices, soups, etc., are particularly effective in this respect." Howell says that "certain common articles of food, such as bread and white of eggs, have no effect of this kind at all." He speaks of the "mechanism of secretion," and divides it into groups: (1) The psychical secretion, (2) The secretion from secretagogues contained in the food, (3) The secretion from secretagogues contained in the products of digestion. He makes the statement that the chemical nature of these last named stimuli is undetermined. One may clearly say that all glands in the human body are stimulated to activity by something which has to do with the body economy.

II.

In classifying and recording my observations on the material in Drs. Mayo's clinics I have found the following scheme of value, not only to the pathologist but especially to the clinician. For their



FIG. 1.—Fœtal thyroid.

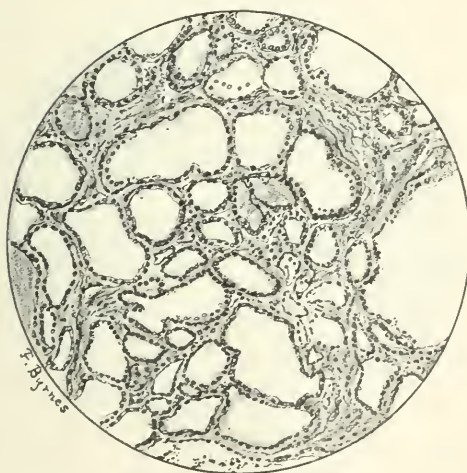


FIG. 2.—"Normal" thyroid.

convenience I have tried to state the conditions, "types" of normal thyroid and goitre, as we know them. The following classification has been adopted as the simplest, and represents the histological types or stages of goitre, from which the clinical picture may be deduced.

The foetal thyroid (Figs. 1 and 7*a*) contains no histological visible secretion so far as we know, and yet it is the forerunner of some of our goitres (foetal adenomas) (Fig. 6) which retain the foetal type. Diagrammatically it may be represented in Fig. 7*a*). The "normal" thyroid (Figs. 2 and 7*b*) is composed of alveoli lined by one layer of

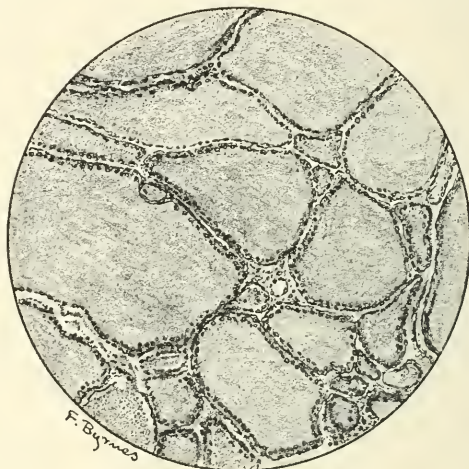


FIG. 3.—Cystic thyroid.



FIG. 4.—Hypertrophic parenchymatous goitre.

epithelium; it secretes some substance, and contains a probably partially non-absorbable substance known as colloid, some of which at least remains in the alveoli. In the "simple goitre," or cystic goitre (Figs. 3 and 7*c*), in which the alveoli are large and filled with colloid, there is an excess of secretion and production of colloid

without an equal amount of absorption, and the condition may be represented by Fig. 7c. This type corresponds to the cystic kidney which gives no symptoms, but is still functioning, and is compatible with the life of the individual. In the type known as "exophthal-

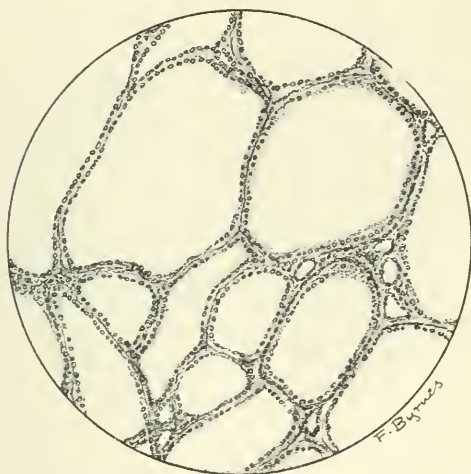


FIG. 5 a.—Cystic goitre.

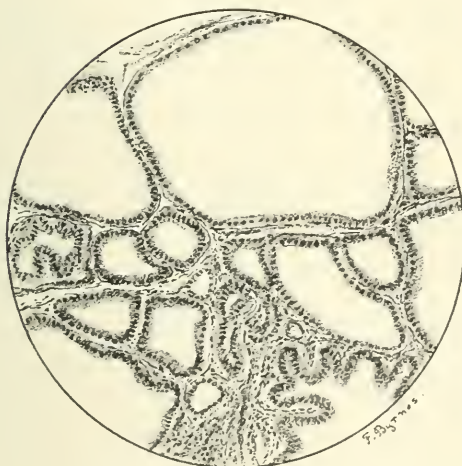


FIG. 5 b.—Papillary cystic goitre.

mic goitre" (Figs. 4, 7d, and 7e) there is an excess of secretion and increased absorption, with slight if any increase in colloid production. This type corresponds to the condition in the kidney and liver in which there is absorption without cyst formation or partial cyst formation.

There may also be a stage in which the symptoms are very exces-

sive, and in which, histologically, an extreme cytolysis is seen. We, therefore, have a condition of extreme excess of the products of the degenerating cells with increased absorption which, however, may not necessarily be equal to the amount of secretion. This may occur



FIG. 6.—Fœtal adenoma of the thyroid.

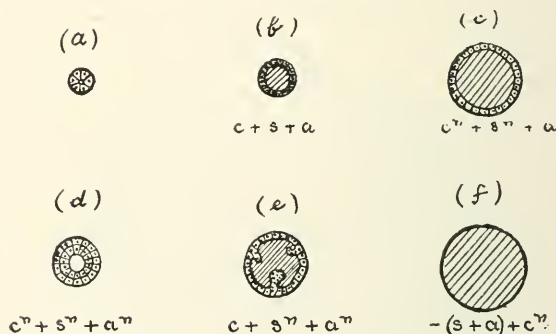


FIG. 7.—Diagrammatic representation of *a*, the fœtal thyroid; *b*, normal thyroid; *c*, cystic goitre; *d*, hypertrophic parenchymatous goitre; *e*, papillary cystic goitre; and *f*, the cured type of cystic goitre. In the algebraic representation of the conditions, *c*, equals colloid production; *s*, absorbable secretion, and *a*, the process of absorption. Any of these may be increased in the conditions, and this is represented by raising the letter to the *n*th power.

in the papillary cystic (Fig. 5 *b*), hypertrophic parenchymatous (Fig. 4), and fœtal adenoma (Fig. 6).

There is still another stage, which may be termed the cured stage (Fig. 7 *f*); cases which have withstood the overgrowth and excess of secretion and cytolysis until there remains a large tumor composed of alveoli, lined by thin connective-tissue or atrophic cells instead of healthy epithelium, and filled with colloid material. These patients suffer only the inconvenience of a tumor without the toxic effect.

True enough, however, some of these go on to myxœdema as a result of the lack of secreting surface. This condition is really a minus condition, or a condition of hypothyroidism (Fig. 7 *f*). It may be well compared to the hydronephrotic or cystic kidney, which has little or no functioning surface. These types or stages are those which we recognize both histologically and clinically.

If we assume that the thyroid has a more extensive function in primitive man than it has at present, and we are from analogy perhaps justified in making this assumption, we must endeavor to express the condition in primitive man.

First, however, the human organism today contains a "normal" thyroid which represents colloid production, an absorbable secretion, the process of absorption, and no excretion into the alimentary canal. The welfare of the organism is dependent upon its food supply, the process of digestion, and air, and would live advantageously if it were not for the entrance of antagonistic organisms or substances through the portals of entry, the substances which arise in the intestine, or as a result of metabolism. Normal man and his relations to his thyroid may be expressed by saying that he has air, food products (including water), the process of digestion, and a glandular organ (thyroid), which produces colloid material, an absorbable secretion, and shows the process of absorption, but does not empty its secretion into the alimentary canal.

Primitive man had air, food products (including water), the process of digestion, and a glandular organ (thyroid) which produced a secretion which was excreted into the alimentary canal, because we assume that his relations to the thyroid were only different from the present relations in that the thyroid had a more extensive function and emptied its secretion through the thyroglossal duct into the alimentary canal, where it probably had some function which does not exist as such, at least to the same extent, in present-day man.

From a knowledge of the process of secretion in other glands based upon experimental evidence, such as the experiments upon the duodenum with hydrochloric acid which produces some substance which gets into the circulation and thus stimulates the pancreatic and hepatic secretion, and the process of secretion in the breasts as stimulated by the developing foetus in utero, and perhaps also the increased secretions of the salivary glands, which may have some chemical stimulus, I have been led to consider a somewhat similar process in connection with the original normal activity and the abnormal activity of the thyroid gland. What the stimulating thing is, living or dead, organic or inorganic, is at present not known. The possibilities may be briefly stated as follows: (1) The stimulating something may be in the food products (including water); (2) it may be in the products of metabolism; (3) it may be in the air which the individual breathes; and (4) in accordance with the hypothesis of this paper the unknown stimulating substance is supposed to be

the unknown substance which stimulated the gland to activity in primitive man, it acting in cases of goitre upon a rudimentary gland.

Without regard to the etiological factor or the nature of the process in goitre, but for the use of the pathologist and clinician, the material which I have studied may be grouped under simple convenient headings. The terms "exophthalmic" goitre, "colloid" goitre, and "simple" goitre, etc., have no very definite histological meaning, nor have they any definite clinical meaning as we now understand the conditions. We, therefore, should attempt a classification based upon pathological findings in exophthalmic goitre which have been well worked out by my colleague, Dr. Wilson, and the other types as worked out from my observations.

The "simple" goitre or "colloid" goitre which we recognize clinically as an enlargement of the thyroid without symptoms other than pressure, should properly be called a cystic thyroid or cystic goitre (*thyroidea cystica*) (Figs. 3 and 7*c*), because the tumor histologically is composed of multiple small or large cysts with their contents. The term "exophthalmic goitre" is based upon one clinical sign, exophthalmos, which is not constant in cases of hyperthyroidism. On the other hand, there are cystic goitres which sometimes show exophthalmos, and hyperthyroidism with or without exophthalmos.

There are two conditions connected with the "exophthalmic goitre," as it has heretofore been generally although not commonly understood, which seem positive. One is the histological picture of increase in the epithelial or secreting surface of the gland, and the other, the clinical condition, hyperthyroidism. Histologically, therefore, this stage may be termed hypertrophic parenchymatous goitre or thyroid (*thyroidea parenchymatosa hypertrophica*) (Figs. 4 and 7*d*). There is little or no cyst formation, but only a hypertrophy of the parenchyma.

A third type or stage is clinically and histologically the cystic goitre, which at some period develops symptoms of hyperthyroidism and which histologically shows the cysts filled with colloid material as in the cystic goitre, with the addition that there are papillary projections into the lumina of the alveoli with consequent increased secreting surface, therefore, approaching the hypertrophic parenchymatous goitre histologically and clinically. This type may be the papillary cystic goitre or thyroid (*thyroidea cystica papillare*) (Figs. 5*a* and *b*, and 7*e*).

A fourth type or stage is that one seen histologically as a hypertrophic foetal thyroid in which there is a small amount of epithelial tissue and a great amount of interglandular connective tissue. Clinically, this type is the goitre of the cretin with tumor formation and hypothyroidism. We shall call this condition hypertrophic foetal thyroid (*thyroidea foetalis hypertrophica*).

A fifth type and a more common type than the last one is the foetal adenoma or adenomatous hypertrophy of foetal thyroid instead of the

connective-tissue hypertrophy seen in the last type. This type clinically is seen usually as a tumor which may or may not cause any other inconvenience than that of pressure. It usually is an encapsulated tumor in the thyroid, and can be shelled out. However, when the encysted or encapsulated foetal adenomas occur, the tissue may degenerate from some unknown reason, or perhaps from circulatory changes due to the thickened capsule, and then the products may be rapidly taken up by the lymphatics and thrown into the circulation, giving symptoms of hyperthyroidism. This type may be termed foetal adenoma of the thyroid (*thyroidea foetalis adenoma tosa*) (Figs. 6 and 7 *a*).

RESUME. 1. The process of goitre may be a process of reversion of the thyroid gland to some former function.

2. Hyperthyroidism is a toxemia the result of absorption of the products of the hyperactive thyroid.

3. The stimulus causing the hyperactivity may be the same that stimulated the thyroid to activity in primitive man.

4. This stimulus was then probably a normal stimulus to the gland, just as we have normal stimuli for glandular activity in man in his present condition.

5. This stimulus may still be present in the food or water, formed through some process in the intestine or in the metabolism of the body, or it may exist in the air.

6. The types of goitre are probably not types but stages in a general process.

7. Goitre may be classified upon a pathological basis as follows: (*a*) Cystic goitre (*thyroidea cystica*) (Fig. 3). (*b*) Hypertrophic parenchymatous goitre (*thyroidea parenchymatosa hypertrophica*) (Fig. 4). (*c*) Papillary cystic goitre (*thyroidea cystica papillare*) (Fig. 5 *a* and *b*). (*d*) Hypertrophic foetal thyroid (*thyroidea foetalis hypertrophica*). (*e*) Foetal adenoma of the thyroid (*thyroidea foetalis adenomatosa*) (Fig. 6).

8. Hyperthyroidism always occurs in *b* and *c*, and may occur in *e* (Figs. 4, 5, and 6).

THE NATURE, DIAGNOSIS, AND TREATMENT OF METABOLIC OSTEO-ARTHRITIS.

SO-CALLED RHEUMATOID ARTHRITIS, ARTHRITIS DEFORMANS, ETC.

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In a series of papers on the classification of the joint diseases generally known as rheumatoid arthritis, arthritis deformans, etc., published in this journal,¹ this supposed group of joint diseases was shown to be composed of a number of dissimilar diseases. It was

¹ January, April, December, 1906.

further shown that the joint diseases generally, and with them the so-called rheumatoid affections, like the diseases of other organs, could be divided into two fundamental classes—the inflammations (infections), and the degenerations (trophic diseases). Moreover, it was shown that the joint diseases could be further subdivided, according to the original location of the disease, into synovial forms (arthritis) and osseous forms (osteo-arthritis), so that by the use of four simple and definite names we could indicate a definite clinical entity corresponding to definite pathological changes, without having recourse to a long description of the malady in order to make our meaning clear to others.

Thus, there is: (1) Infectious arthritis, an infectious joint disease involving the soft parts primarily; (2) infectious osteo-arthritis, an infection involving the bones primarily; (3) trophic arthritis, a degenerative joint disease involving the synovia only; and (4) trophic osteo-arthritis, one involving both the bones and soft parts. These names, it was shown, could be made still more definite when the etiology is known; so, for instance, pneumococcic osteo-arthritis, a pneumococcic infection involving the osseous structure of the joints, having the general characters of infectious osteo-arthritis; or neurotic osteo-arthritis, a trophic degenerative change involving the osseous joint structures due to nerve lesion—as in tabes, syringomyelitis, etc. In the last paper of the series it was shown that by means of this classification the so-called rheumatoid conditions could be differentiated from one another clinically.

However, as these papers were simply preliminary, giving only a general view of the subject, many details of the pathology, etiology, and the symptoms of the various diseases were purposely omitted in order to simplify the subject. This was particularly the case with the disease designated as metabolic osteo-arthritis and corresponding to Schuchardt's arthritis nodosa, Baumler's arthritis deformans, and Goldthwait's atrophic arthritis, of which only a few leading features were discussed. As this disease presents many interesting features which are still misunderstood, or the subject of controversy, and, as I believe, the results of my investigations are definite enough to give us a more intelligent conception of the disease, I purpose to deal with this subject, in detail, in the present communication.

In studying a disease of an organ the first point to be decided is, Is it a local condition, causing secondary general symptoms, or is the disease a part of some general condition, that is, is the disease primary or secondary? If the disease of the organ is primary, the study of the pathology and symptomatology as they refer to the organ may lead to a better understanding of the etiology and pathogenesis of the disease. When, however, the disease of the organ is secondary or a part of some general morbid process, the study of the local condition can, of course, never lead to a true conception of the disease itself.

Though the majority of observers have looked upon metabolic osteo-arthritis as a joint disease caused by some uniform general abnormality, the search for the cause and pathogenesis has nearly always been confined to the joints only. It is true that for many years a general metabolic abnormality (excess of uric acid) has been considered the cause of the joint disease and of the general condition; but since it has been shown² that uric acid has nothing to do with the disease, only the local condition has been considered. If, as has been assumed, metabolic osteo-arthritis is a general disease, it is futile to expect to discover the pathogenesis or cause by studying the joint condition only. The most we could hope for would be a better understanding of the local condition. But not even the joint condition has been carefully studied. The descriptions of the symptoms and course of the disease to be found in the general literature are either inadequate or inaccurate; and the pathology, studied in subjects (dead of some intercurrent malady) without a history of the joint disease, or by means of museum specimens without any clinical data whatsoever, is seriously misconceived. In the present instance it is, therefore, necessary to arrive at a definite understanding of the local condition, before we can discuss its relation to the general manifestations of the disease or of the disease itself. Hence, the study of the subject is divided into the following parts:

1. The study of the joint conditions: (a) to establish a clinical entity; (b) the diagnosis of the joint condition, that is, its differentiation from all other joint diseases.

2. The pathology of the joint disease. Not the pathology of a general disease is intended, but only the anatomical findings in the joints of individuals who have presented, during life, the joint condition herein described.

3. Having established a definite joint condition with definite and easily recognizable anatomical changes, the general symptoms presented by individuals with such a joint abnormality will be discussed.

4. From the study of the joint symptoms and the general symptoms, I shall attempt to decide whether the disease is primarily a joint disease causing general symptoms or a general disease with joint involvement.

5. Granting the disease is general, the question then to be decided is, the nature of the general condition. Is it a definite and specific abnormality, or might not, as is so often the case with other joint diseases, a number of dissimilar general conditions be instrumental in its production.

6. These points having been more or less satisfactorily settled, a method of treatment which in my hands has been of benefit, will be detailed.

² McCrudden, *Uric Acid*, Boston, 1905.

THE JOINT-SYMPTOMS. *Muscular Atrophy.* Muscular atrophy is always a very early symptom of joint disease, and not infrequently can be detected before the other physical signs of joint disease present themselves. In no other joint affection, however, does it appear so early, or is it so marked as in metabolic osteo-arthritis. Not only does it appear early, but it progresses more rapidly and quite out of proportion to the other joint manifestations. At times it becomes extreme; and when the disease attacks the joints of the hands and fingers, which is usually the case, the condition might be mistaken for one of paralysis. Indeed, when flexion deformity predominates, the hands may exactly resemble the paralytic claw hand (Fig. 1). Though the muscular atrophy is not always so intense, it is very



FIG. 1.—Pure flexion deformity in metabolic osteo-arthritis in a girl aged ten years. There is no swelling; the hand resembles the paralytic claw hand. The disease had existed for four years.

marked in the majority of cases; and whatever may be its cause in other joint diseases, it seems to me quite improbable that this extreme atrophy, which is present so early and whilst the limb is still in condition to perform at least some of its functions, should be due to the joint disease alone.

Subjective Symptoms. The earliest symptom complained of by the patient is joint stiffness. This is much more pronounced when the disease begins in the hands, and especially so in those engaged in pursuits which require fine manual adjustments. The stiffness is said to be more severe upon arising in the morning, and gradually disappears to a certain extent during the day. As time goes on, however, it extends over longer and longer periods, and finally becomes constant. If the joints are examined during this time,

before joint swelling and the signs of actual joint irritation have made their appearance, it will be found that passive motion is hardly, if at all, limited, though the patient complains of the stiffness. It, therefore, seems more probable that what the patient calls stiffness is really weakness. Indeed, the more intelligent patients do not complain of stiffness, but of gradually increasing weakness. With the weakness various other subjective symptoms are present. Patients complain of formication, etc., and pain.

Pain. Pain is a most variable symptom. It not only varies in the different individuals, but in the different joints of the same individual. In some joints the disease runs its course with slight or no pain at all; in some it is severe but transitory; in others it is intense, constant night and day, and unaffected by immobilization for weeks or months. The character of the pain is similarly variable; it may be dull or sharp and lancinating, and may or may not be increased by passive motion. When present it is always increased by pressure upon the bone near the joint.

As all these patients are chronic invalids and many of them present decided signs of functional nervous derangement, I have often been unable to decide whether or not the pain is due to nervous influences. In some cases I indeed suspected an hysterical element; but in the majority of them the long-continued sleepless nights and the total failure of suggestive treatment (hypodermic injections of water, etc.) have convinced me that the pain is real and not imaginary; the more so as I have known it to be very intense in patients with absolutely no neurotic symptoms. In one case (a lady, aged thirty-five years), with all the joints involved except the spine and maxillæ, the pain in the ankles continued intense for a number of weeks, and nothing relieved her but opium given in suppositories. After the pain ceased the patient discontinued the suppositories voluntarily.

So far as I can make out, the pain does not correspond to any particular stage of the disease. It is usually present early, and in the majority of cases is most severe when the disease is most active. It usually subsides with the subsidence of the joint destruction, but it may be mild in the earlier stages and very severe later on. In certain forms of the disease in children there is practically no pain at all.

Joint Swelling. The peculiar form of swelling which occurs in metabolic osteo-arthritis has been considered by the earlier English and French writers the most characteristic symptom of the disease. Because of it, Heygarth named the condition nodosity of joints; Trousseau called it *rheumatisme noueux*; and still more recently Schuchardt called it *arthritis nodosa*. There can be no question that the peculiar nodular swelling is a very characteristic symptom; but the swelling is not always nodular; if present at all, it is only present for a limited time; and it may be masked by joint effusion.

Weakness or stiffness, pain, and other subjective symptoms pre-

cede the joint swelling by a variable length of time. This interval depends upon two factors: (1) The rapidity of the progress made by the disease; (2) the external mechanical conditions. In some cases atrophy and weakness progress rapidly; the affected extremities are painful and soon become so weak that active function is impossible. In these, when the disease attacks the upper extremity, it runs its course uncomplicated by mechanical joint irritation, and the characteristic joint swelling soon makes its appearance. In others the weakness is very slowly progressive, and in those whose occupation does not entail the constant use of the affected parts, the preliminary joint symptoms may exist for some time



FIG. 2.—The hands in a very early stage of metabolic osteo-arthritis. There is no effusion, but a very slight spindle-form swelling. The fingers are just beginning to deviate laterally.

before joint swelling. On the other hand, in those who use the extremities constantly or violently the joint swelling soon makes its appearance whether the disease progresses rapidly or not.

Not only is the period before the advent of joint swelling variable in correspondence with the internal and external conditions, but the character of the swelling depends upon them. Thus, in those cases with severe, rapid progress and early cessation of function, it comes on gradually, is at first spindle shaped (Fig. 2), and later, due to a thickening of the soft parts, assumes the characteristic nodular form (Figs. 3 and 4). When the disease progresses more gradually and more slowly and the early subjective symptoms are milder, it permits of more or less active function for a longer period. In such cases, the joints perform their functions under abnormal conditions, and, as a



FIG. 3.—Symmetrical and general nodular swelling in a case of metabolic osteo-arthritis. The glands and spleen are enlarged and palpable. So-called Still's disease.



FIG. 4.—Nodular swelling of the hand and finger-joints in metabolic osteo-arthritis. In this case all the joints except those of the head and neck were involved. The liver, spleen, and glands were enlarged (Fig. 15).

consequence, the symptoms of joint irritation usher in the disease. The swelling then appears abruptly, is irregular or spindle-shaped, and, besides thickening of the soft parts, there is joint effusion. In this event, with the appearance of the swelling, there is loss of motion, pain, and deformity (in the hands the appearance is illustrated in Fig. 5). For this reason the joints are put at rest and the effusion then subsides to a certain extent, leaving the doughy spindle-shaped or nodular swelling behind. In the more energetic or in those who are compelled to work, depending upon the rapidity of the advance of the disease, this sequence may be repeated a number of times. It must, however, be remembered that the effusion is often very slowly absorbed, and in a fair number of cases remains permanently.



FIG. 5.—Flexion deformity with reactive effusion in metabolic osteo-arthritis. The effusion in this case almost completely disappeared when the joints were put at rest.

As joint effusion may occur from joint irritation, irrespective of the cause, it cannot, of course, be considered a characteristic symptom of any form of joint disease. Nor is nodular swelling an absolutely pathognomonic symptom of metabolic osteo-arthritis. In children it frequently involves all the joints of the extremities and remains present throughout the course of the disease (Fig. 2). But in adults, though it is nearly always present in the knees, it rarely involves the smaller joints of hands and toes. Moreover, certain forms of poly-articular infection with para-articular involvement which occur in children are characterized by a doughy nodular swelling of the joints. Such cases have frequently been mistaken for metabolic osteo-arthritis or have been considered analogous to it (rheumatoid arthritis,

arthritis deformans); and when, as sometimes happens, there are swollen glands, they have been described as Still's disease. This will be more fully dealt with later.

Joint Deformity. With the advent of the swelling, or soon after, muscular contraction, and with it joint deformity, makes its appearance. To the deformity the disease owes one of its most popular names. Virchow, I believe, first named it arthritis deformans. Following him, a great many Germans, and more recently some English writers (Garrod), call it so. Charcot, whilst he did not adopt the name, also considered the deformity one, if not the most, characteristic part of the condition. Indeed, he went so far as to divide the cases into types, according to the various forms of deformity which occur in the hands.



FIG. 6.—Palisade deformity in metabolic osteo-arthritis. There is no swelling.

The most characteristic deformities occur in the fingers. They are the so-called palisade deformity: flexion of the middle and extension of the terminal phalangeal joints (Fig. 6); deviation of the fingers to one side (Fig. 7); and flexion of the phalangeal, and phalangeal metacarpal joints (Fig. 1). Various forms of deformation may exist in the same patients in different joints, and combinations of any or all of them occur. In the larger joints the deformity differs in no wise from that which occurs in all other forms of joint disease. The knee is flexed and perhaps adducted; in the hip flexion and abduction are later succeeded by adduction and internal rotation.

Here, as in other joint diseases, the deformity depends upon two factors, viz., muscular contraction and tissue destruction. In the early stages deformity is due to muscular contraction alone, in the later stages to a combination of muscular contraction and bone destruction. In no other condition is this so well exemplified as in metabolic osteo-arthritis. In this condition, as well be shown later,

rarefaction and softening of the articular ends of the bones precedes or is concomitant with the earliest joint symptoms. The softened bone not only gives way as the result of the pressure of muscular contraction and weight bearing, but later the location of the softening and absorption directly influences the extent and direction of the deformity. In the terminal stages of the disease, the articular ends of the smaller bones (fingers and toes) are more or less completely absorbed, and to this is due the striking deformity of the fingers. By means of a series of x-ray pictures the gradual evolution of the deformity may be graphically depicted.

Loss of Motion. Loss of motion depends upon a number of contingencies. In the early stages, as has been said, weakness is apt to be mistaken for stiffness, but later, when there is swelling and mus-



FIG. 7.—Lateral deviation of the fingers without swelling in metabolic osteo-arthritis.

cular contraction, there is, of course, real limitation of motion. In those cases in which the swelling remains nodular, contraction may be slight or transitory or entirely absent and passive motion may not be interfered with to any great extent. When muscular contraction is present, which sooner or later is the case, passive motion, unless there is mechanical joint irritation, is limited to the extent of the contraction, and the joint is quite freely movable within the limits of the contraction. So, for example, flexor contraction of the knee limits the motion in extension, but the knee may be still further flexed without difficulty. When, however, the contraction has existed indefinitely, and the joints are retained in one position for a long time, there is apt to be some further limitation of motion. Except during the transitory periods of joint irritation the limitation of

motion is never absolute, nor does it keep pace with the progress of the disease; for patients with extensive disease and much deformity often have a considerable range of passive motion.

Though some of the joint symptoms are peculiar and often very characteristic, it is evident that in metabolic osteo-arthritis, just as in other joint diseases, it is hazardous or impossible to make a positive diagnosis upon the intrinsic joint symptoms alone. Owing to their superficial situation and their peculiar functions (motion and weight bearing), the joints themselves present essentially the same intrinsic symptoms in all forms of disease. Thus, pain, swelling, muscular spasm with its attendant deformity, and loss of passive or active motion appear as symptoms of not only all forms of joint disease, but, indeed, may be induced by joint irritation caused by an abnormality near, but not directly involving the joint at all.

Hence, though advanced cases of metabolic osteo-arthritis present such a peculiar and characteristic deformation of the fingers that the diagnosis can be made from it without any difficulty, these symptoms are not so definite in the other joints and are not present at all in the early stages of the disease. Nodular swelling, characteristic as it is, is not pathognomonic; for such a swelling may appear in any condition with peri-articular infiltration and thickening. Pain is all extremely variable symptom. Muscular contraction is present in all joint diseases and deformity is dependent altogether upon mechanical conditions. We are here, as elsewhere, therefore, compelled to depend upon the influence which the character of the morbid process exerts upon the onset, course, and termination of the joint condition and upon the actual condition in the joint as shown by the radiograph, for the diagnosis. In metabolic osteo-arthritis this influence is definite and characteristic.

Onset and Course. The condition is always polyarticular and symmetrical. It always attacks the peripheral joints first and a number of joints are usually affected simultaneously. The onset is invariably insidious. There is no foundation for the division into acute, subacute, and chronic cases, advocated by Garrod. This classification, which is based upon the abrupt onset of the swelling, has led to the confusion of this joint condition with certain forms of polyarticular infection with which it has absolutely no connection. The abrupt onset of the joint swelling is due, as has been already explained, to mechanical irritation, and careful (not suggestive) inquiry will always elicit symptoms which have preceded the swelling. In a large percentage of the cases the disease comes on so insidiously that the patient is unable to state definitely just when the trouble began.

Not only is the onset insidious, but in cases uncomplicated by joint irritation the course is gradually progressive. In some cases, it is true, the disease progresses more rapidly than in others, but even in the most rapidly destructive forms the disease advances gradually,

and there is never a really abrupt onset and acute local and general reaction. In the majority of cases the disease progresses slowly and very gradually. Preceded by more or less decided subjective symptoms, a number of joints become weak or stiff. With increasing weakness or stiffness joint swelling appears; hardly perceptible at first, when uncomplicated by mechanical joint irritation, it gradually increases, becomes spindle-shaped, and then perhaps nodular. In many cases the nodular appearance of the swelling is due to the extreme atrophy of the peri-articular structures and not to thickening of the joint membranes or bones. Thus it remains for a variable length of time, when it just as gradually recedes, finally disappears altogether, leaving the joints atrophied and deformed. The deformity, in its turn, increases by degrees, and though passive motion may not be markedly limited, it gradually and progressively leads to crippling. In the meantime new joints become involved in the same insidious and progressive manner, and in the severer cases, beginning in the periphery and proceeding toward the trunk, all the joints, including those of the spine, may become involved. Though there are never intermissions, even in severe cases, there are times when the disease progresses less rapidly or remains stationary for a variable length of time. The periods of apparent quiescence may, indeed, continue for several years; but in the severer forms the condition ultimately resumes its relentless course and the individual finally becomes a helpless cripple.

In the milder cases the disease progresses very slowly, with long periods of quiescence and less extensive crippling. In some cases, indeed, the disease, after progressing to a certain extent, seems to remain stationary, and though the affected joints remain crippled, no more joints become involved. It is, however, very difficult to say definitely that the disease will make no further progress in a given instance; for it not infrequently again becomes active and progressive after years of quiescence.

Differential Diagnosis. With one exception (polyarticular form of senile osteo-arthritis, Heberden's nodes) there is no other chronic polyarticular joint condition in which the joints are symmetrically and progressively involved. In children the condition, because of the absence of joint irritation (they are not compelled to use the joints in spite of pain and disability, as adults often are), occurs in its purest form. In them the nodular swelling, which comes on very gradually, remaining present for a very long time, with slight or no loss of passive motion, is so characteristic that it is quite impossible to mistake it for any other joint abnormality. In adults, however, the inexperienced observer may occasionally find difficulty in making the diagnosis. This is most apt to be the case when the disease comes on very insidiously and progresses very gradually. In such cases the prodromal symptoms, being slight, may be overlooked and the frequently recurring symptoms of joint irritation might lead one to

believe there are recurrent attacks with an abrupt onset. Under these circumstances the slight rise in temperature which is occasionally present has led many otherwise good observers to believe that the malady is infectious. But if it is remembered that the polyarticular joint infections are always due to a general infection (sepsis), that the onset is very acute, with marked constitutional symptoms and rapid but not progressive joint involvement, this mistake in the diagnosis is readily avoided. What has caused most confusion in regard to the differentiation of these conditions are the cases of infectious polyarticular joint disease seen long after the initial disease



FIG. 8.—Radiogram showing the condition of the bones in a very early stage of metabolic osteo-arthritis. This picture is taken from a radiogram of the hands shown in Fig. 2. The arrows point to the rarefied areas. (Radiograms to show these changes must be properly exposed and developed very carefully.)

has subsided. In these, if the history is not obtained, the deformed and stiff joints of the hands may lead the surgeon to believe he has a chronic joint disease to deal with. Indeed, these cases are nearly always mistaken for cases of metabolic osteo-arthritis, and called rheumatoid arthritis, or arthritis deformans. This is unfortunate, for in cases of polyarticular infections we are not dealing with an active joint disease at all, after the acute attack has once subsided, but simply with the deformity and stiffness; that is, the result of the disease. A history of the case, that is, sudden onset with high temperature and symptoms of profound intoxication, which may or may

not have been recurrent, are diagnostic of the polyarticular infections and readily distinguishes them from metabolic osteo-arthritis. If for some reason the history is not obtainable, the fact that the joint lesions are not progressive and that the joints are always ankylosed (bony) when the bones are involved, and show no bone changes at all when the bones are free, readily clears up the diagnosis.

When cases cannot be observed for any length of time, or when for some reason the diagnosis is doubtful, the *x*-rays will always definitely



FIG. 9.—Radiogram of the hands in a more advanced stage of metabolic osteo-arthritis than is shown in Fig. 8. The rarefaction has spread, some of the epiphyses are distorted, and some of the joints are subluxated. The pressing together of the softened carpal bones gives the appearance of bony ankylosis; but there is no ankylosis, for the joints can be moved passively.

decide it. Good radiograms, particularly of the small joints of the extremity, show very characteristic pictures in the earliest stages of the disease. Even before there is deformity, a characteristic rarefaction of the bones can be easily made out. At this time, the rarefaction is confined to small circumscribed areas in the epiphysis just below the cartilage (Fig. 8). As the disease advances these areas are found to become gradually larger (Figs. 9 and 10) (more and more bone becoming absorbed), and in the case of the smaller joints the epiphysis, as a whole, may finally disappear. This peculiar form

of rarefaction differs radically from that shown by x -ray pictures in the polyarticular forms of infectious osteo-arthritis. In the latter it is diffuse from the beginning, not infrequently involving the shaft (Fig. 11). When recovery is not complete in the later stages it is always accompanied by periosteal outgrowth and bony ankylosis (Fig. 12). In the early stages of the other forms of trophic osteo-arthritis (senile and neurotic osteo-arthritis) the same form of rarefaction occurs; but as these forms of joint disease practically always involve the larger joints, the changes are not so readily made out. The senile and neurotic forms of osteo-arthritis are easily differentiated from metabolic osteo-arthritis by the presence of periosteal



FIG. 10.—Radiogram of the hands shown in Fig. 1, an advanced case of metabolic osteo-arthritis in a child, with extreme rarefaction. All the joints can be passively moved. Here as in all cases of metabolic osteo-arthritis there is no proliferation or hypertrophy.

outgrowths of various kinds, the so-called hypertrophic processes. As a result of the softening of the bones in metabolic osteo-arthritis, the articular ends of the bones, particularly of the large joints of the lower extremity, become distorted in the later stages of the disease. This is, of course, readily made out in the x -rays. At times the softened bones spread as the result of weight bearing, and occasionally, particularly in the knee, the thin edges of the articular surface turn over. These lips have been mistaken for periosteal or cartilaginous outgrowths, in the interpretation of the x -ray pictures, by some observers. Careful observation in conjunction with the examination of pictures of other joints will prevent such an error.

If we combine the characteristic clinical phenomena with the x-ray findings in metabolic osteo-arthritis, we have a symptom complex which is pathognomonic. Hence, if a given case of joint disease is polyarticular, involving the peripheral joint first, with a marked tendency to be symmetrical, if the course of the disease is gradually progressive, new joints being involved from time to time; if the physical joint changes begin with swelling which is followed by gradually increasing deformity; and if the radiograms show the



FIG. 11.—Radiogram of the hands in infectious osteo-arthritis, showing the tendency of the rarefaction to involve the shaft immediately. The left hand was first affected, and the disease, which had here run its course, has led to bony ankylosis in the fourth and fifth fingers.

peculiar pinched-out rarefaction in the early stages, and the absorption and distortion in the late stages, without the presence of proliferative processes or bony ankylosis, no matter what other condition may be present, it is absolutely certain that the joint disease is metabolic osteo-arthritis. And only when this combination of symptoms is present are we dealing with this condition.

As time goes on, and we become more familiar with the scientific differentiation of joint disease, there is no reason why, with such

striking clinical phenomena, the diagnosis should not be made without the aid of the x-rays.

PATHOLOGY. As was said in the beginning, the main cause for the misconceptions which prevail regarding the chronic joint diseases is, that the pathology has not been studied in conjunction with clinical observation. With one exception (Kachel¹) pathological findings have been described as derived from cases of arthritis deformans or rheumatoid arthritis, without an adequate, or, in some instances, without even a hint of the clinical history of the case. Hence, as the ideas of what was arthritis deformans or rheumatoid arthritis differed, and as the pathological specimens were often obtained from totally different conditions, it was only to be expected that misconception should ensue.

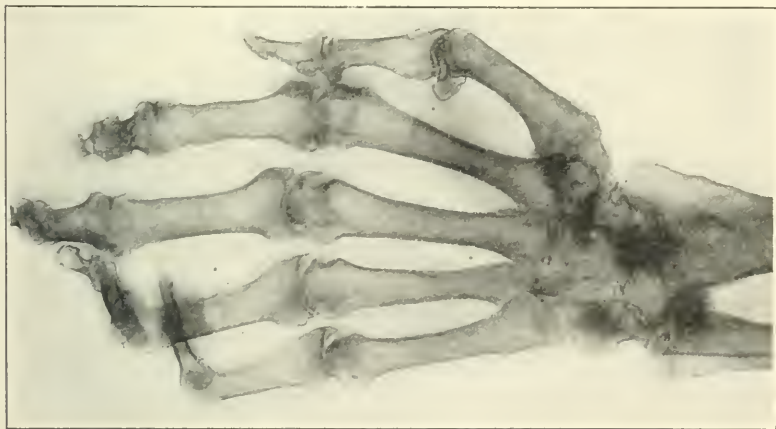


FIG. 12.—Radiogram of the hands of a case of polyarticular infectious osteo-arthritis, which ran its course many years ago. Bony ankylosis and diffuse rarefaction of the shaft have occurred.

In the present instance particular care was taken to study the pathology only in such cases in which the clinical diagnosis was unmistakable and corresponded to the symptom complex here designated as characteristic. The pathological study here presented is based upon six cases which came to autopsy. About thirty joints were carefully examined, both macroscopically and microscopically. Besides the cases in which there was a complete autopsy, I have examined individual joints, ten in number, from various sources in which the clinical diagnosis was positive.

In the majority of instances the description of the pathology of metabolic osteo-arthritis begins with a description of the changes in the synovial membrane or the cartilage, and I believe nearly all authorities are of the opinion that the disease begins in one or the

¹ Untersuchungen über Polyarthritis Adhesiva, Ziegler's Beiträge, Band xxxiii.

other of these structures. Under these circumstances, one who studies the pathology of metabolic osteo-arthritis is surprised to find the cartilage quite normal and the capsule with insignificant changes during the early stages of the disease. Upon opening a joint which had shown distinct abnormality during life (swelling, pain, deformity), one often finds little besides capsular irritation and a small amount of effusion in the interior. At this stage, though the cartilage is apparently quite normal, the articular ends of the bones, particularly those of the larger joints of the lower extremity, often show considerable distortion. Moreover, if the epiphyses are cut into or sawn, it is found that they are decidedly softer than normal; and if the disease is at all advanced, they may be cut readily with a scalpel.

If a section of the articular end of the bone is examined, one finds the marrow more red, and the trabeculae of the spongiosa diminished in number and thinner than normal. During the early stages the bone atrophy is distinctly subchondral, but it gradually advances and finally involves the whole epiphysis. In a majority of cases at an early stage, one can discover with the naked eye, or at any rate with a low-power magnifying glass, minute cavities situated in the subchondral region of the epiphysis within, or at the edges of the bone trabeculae. These are bone cysts and they vary in size, being of course larger and more numerous as the diseases advances. The more recent ones are apparently filled with a mucilaginous material; the older ones are empty. Besides the cysts there are in the subchondral and later in the deeper portions of the epiphysis as well, opaque areas resembling foci. These focal areas are composed of more or less dense connective tissue. In the later stages these areas of connective tissue have increased considerably, and frequently have coalesced to form extensive areas. In the terminal stage the connective tissue not only invades the deeper portions of the epiphysis, but when the cartilage has in part, or, as a whole, disappeared (which is usually the case), it also invades the interior of the joint.

As has been said the cartilage shows no changes during the early stages of the disease. Indeed, in joints which, because of muscular contraction have been held stiff for a long time, it may be covered to some extent by connective tissue, without showing marked signs of degeneration or ulceration. In such cases the connective tissue is not derived from the cartilage by splitting and fibrillation as the previous writers upon this subject suppose, but can be traced to the zone of capsular insertion from which it originates. It exactly resembles the connective tissue (loosely vascular), which appears in all joints that have been immobilized (without bony ankylosis) for a long time. And I have convinced myself that in cases of metabolic osteo-arthritis, in which it is present before the cartilage has been affected, it is due to the immobilization and is not a part of the pathological process. That it is not part of a proliferative process which beigns in the capsule is evident from the fact that it is frequently present when the

capsule shows no signs of proliferation anywhere else. (It is then exactly analogous to the connective tissue which is found between the joint surfaces in the normal joints of animals which have been immobilized for experimental purposes. In such cases the joint motion is found limited when the retention dressing is removed; this limitation of motion is found to be due to muscular contraction just as in metabolic osteo-arthritis; similarly when the tendons are cut free motion is again possible. In the interior of the joints the cartilage is found covered with a layer of loose, somewhat vascular, connective tissue which exactly resembles that described above).

As the disease advances the subchondral changes increase, and the nutrition of the cartilage being impaired it becomes involved in the pathological process. It loses its lustre, splits, ulcerates, and finally disappears altogether. In the joint disease under discussion, whatever may be the case elsewhere, the joint cartilage never shows any signs of proliferation. It is true that at an early stage, on microscopic examination, one occasionally finds cell multiplication to a limited extent, but here, at any rate, the cellular increase is simply a prelude to degeneration, and there is never an increase in the amount of the cartilage to be made out macroscopically. The chondromas which are described as occurring in arthritis deformans (which by the way are not chondromas at all, but consist of uncalcified osteoid tissue derived from the periosteum) do not occur in metabolic osteo-arthritis. Nor are periosteal outgrowths of any kind ever to be found.

The degeneration of the cartilage varies according to the location and extent of the disease in the underlying bone. At times it appears focal, but close examination will always reveal changes extending some distance from the supposed focus. Naturally, degenerated or degenerating cartilage loses its functional power and hence suffers from pressure. For this reason the so-called cartilaginous ulcer appears where the articulating surfaces are held firmly together by muscular contraction. As soon as a defect occurs it becomes filled with connective tissue. This connective tissue, which comes from the degenerating spongiosa, soon fills up the gap in the cartilage and invades the interior of the joint, where it comes in contact and coalesces with the connective tissue derived from the border of the capsule. In this wise the joint cavity becomes more or less completely filled with connective tissue; and if the cartilage degenerates completely (the usual condition in the terminal stages of the disease), the articular surfaces of the opposing bones are separated, or, more correctly, united by connective tissue. This new-formed connective tissue is not dense, but loose and vascular. There are few round cells within it, and none in the neighborhood. It does not involve the capsule, which indeed may be rudimentary. It shows no marked tendency to contraction, so that it does not cause ankylosis or even marked joint stiffness. When there is limitation of motion in these

cases, it is due to muscular contraction and disappears when the tendons are cut.

The capsular changes, supposed by many to be the earliest, are really insignificant. In the joints in which the disease is just beginning, there is simply a small amount of effusion and some injection. At times there is some hypertrophy of the synovial fringes—but as far as my own cases go, there is never the enormous villous formation described by some authors. Later, the capsule degenerates with the other parts of the joint. It becomes lax, more succulent; the inner surface loses its lustre; the synovial fringes which may have been somewhat hypertrophied during the earlier stages undergo fatty degeneration; and, finally, only a few shreds of degenerated capsule mark its former location.

Thus, macroscopically, the disease manifests itself by a degeneration and gradual disappearance of the joint structures. The bone ends, which in the early stages are distorted and deformed, in the

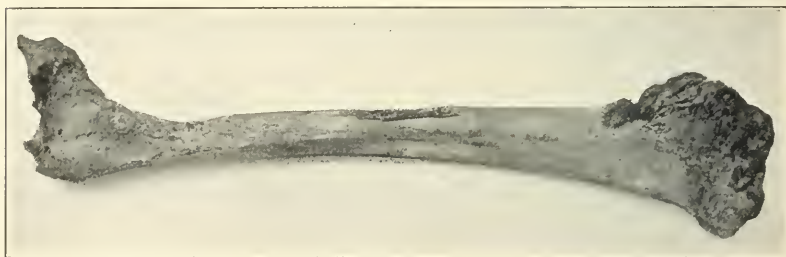


FIG. 13.—Femur from a case of metabolic osteo-arthritis. The head of the femur is almost entirely absorbed; both epiphyses are extremely delicate and break between the fingers like egg-shell.

later stages become rudimentary, and in the small joints disappear entirely. The rarefaction and bone absorption are best demonstrated in the dried specimen. Thus, Fig. 13 represents the femur of an advanced stage of metabolic osteo-arthritis. The femoral head is rudimentary, and the bony tissue is so thin and delicate that it breaks like eggshell between the fingers. Fig. 14 shows a cross-section of the head of the femur in another less advanced case, showing distortion, rarefaction, and cyst formation. Unlike the cases of mon-articular trophic osteo-arthritis, in which the articular ends of the bones are also somewhat rarefied and softened, there are never signs of proliferation (pseudohypertrophic processes) in metabolic osteo-arthritis.

In the terminal stages of the severe cases the small joints almost completely disappear. The opposing articular surfaces are separated by connective tissue, there is no joint cartilage, no joint cavity, and the capsule, ligaments, and even the tendons in the neighborhood are reduced to mere shreds.

Microscopic Examination. Osteomalic and osteoporotic changes are present side by side, and they differ in no wise from those found in other forms of bone degeneration. There can be no question regarding the softening, for on staining with hematoxylin and carmine certain areas of what should be calcified bone, and, therefore, take the carmine stain, are colored blue (hematoxylin) instead. In such areas the bone-cell cavities are larger than normal. The cells show various degenerative changes. At times they are larger than normal, but take the stain with difficulty; later they are shrivelled, the processes are absent, and finally they completely disappear.

The ground substance becomes cloudy and granular. The bone-cell cavities increase in size, a number of them coalescing to form larger cavities filled with a mucilaginous fluid, thus forming the cysts. As the process advances, the bone cysts increase in size, more and more of the softened bone substance being absorbed; thus the

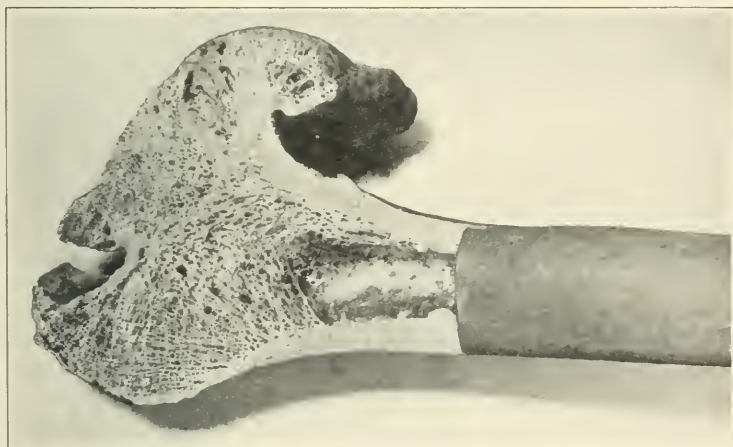


FIG. 14.—Section of the head of the femur, showing the distortion and the rarefaction.

trabeculae become much reduced in thickness, and finally many of them completely disappear. Lacunar absorption also occurs, and Howship's lacunae are to be seen upon the surfaces of the trabeculae.

The marrow shows marked signs of degeneration. The fat is diminished, and in the earlier stages is displaced by a mucin-like fluid. Later the connective tissue fills the spaces between the degenerating trabeculae. In a like manner connective tissue fills the cysts forming the opaque areas seen with the naked eye, and finally, after the disappearance of the cartilage, it penetrates the interior of the joint.

The changes in the cartilage are those which occur in all forms of degeneration in this structure. Proliferating cells occur in the early stage, but these are comparatively few in number and no doubt

simply usher in the degenerative process. The cells assume various abnormal shapes, are stained with difficulty, and ultimately disappear altogether. The cell cavities enlarge, the ground substance loses its hyaline character, becomes granular or fibrillated, and ultimately splits and loses its connection with the bone. In those situations where there is pressure, at times also in other places, the articular ends of the bones become denuded in somewhat circumscribed areas, the so-called ulceration of the cartilage. Such defects in the cartilage become filled in with the connective tissue from the bone below, and and to a lesser extent with that which comes from the border zone of the capsule. These defects or ulcers are not caused by the active invasion of the connective tissue from the interior of the joint into previously healthy cartilage, as described by many writers. This is improbable in any case, because normal cartilage cannot for physiological reasons be invaded by connective tissue. In the present instance there is evidence besides, in direct contradiction to such a method of invasion. In the first place, the bone changes are found to be present both macroscopically and microscopically before the cartilage or capsular changes. In the earlier stages of the disease the capsule and cartilage are not involved, whilst the bone degeneration can be readily demonstrated, if not with the naked eye, certainly with the microscope. If the process is carefully followed it is found that the cartilage begins to degenerate at a stage when the amount of connective tissue, particularly that in the interior of the joint, is insignificant. And, finally, if a number of joints are examined, one is sure to find defects in the cartilage which have not as yet become filled with connective tissue. In the majority of instances, the connective tissue in the ulcers can be directly traced to the bone, and as the joint interior only becomes quite filled with connective tissue in the terminal stages of the disease, considering the nature of the process generally, it seems to me only plausible to assume that it originates within the epiphysis.

The capsule shows no characteristic changes. I have never been able to find the enormous proliferation of the villi spoken of by some authors. I am fully in accord with Shuchardt in this respect. Aside from a slight sign of irritation in the early stages, there is a gradual atrophy of the capsule and ligaments, with or without some indication of fatty degeneration.

Thus the joints in metabolic osteo-arthritis present pathological changes which correspond and readily explain the clinical phenomena. The earliest changes are bone changes, and these early bone changes can readily be demonstrated by *x*-rays during life. The rarefaction which is shown by the radiograph to be subchondral and somewhat circumscribed (punched-out rarefaction) in the early stages, corresponds to the osteomalic and cyst-like osteoporotic condition to be seen in the postmortem specimens. Proliferation processes are never seen during life, and they are never found when the joints are examined after death.

The clinical phenomena indicate that the condition is one of gradual joint degeneration, and the postmortem findings readily bear this out. As a matter of fact, the condition presents a pure form of atrophic degeneration, as was indicated by Shuchardt when he classed this condition as an atrophic joint inflammation. That it is not an inflammation, however, is evident from both the symptoms during life and the pathological changes in the joints.

In metabolic osteo-arthritis we have, then, a perfectly distinct joint condition which can be distinguished from all other joint conditions both clinically and pathologically. Having decided this point, we are in position to inquire whether this joint condition is of itself a disease, secondary to some other disease, or a part of a distinct general condition. Having constantly in mind that whatever the concomitant phenomena, to be spoken of presently, the joint condition in every case remains exactly the same and corresponds in its diagnostic and pathological features to those here detailed as characteristic of metabolic osteo-arthritis, we proceed to the discussion of—

THE GENERAL OR CONSTITUTIONAL SYMPTOMS PRESENT IN PATIENTS WITH SUCH A JOINT CONDITION. A fairly large percentage of cases shows no definite general abnormality of any kind, except a variable degree of cachexia and secondary anemia throughout the course of the disease. In the milder cases the anemia and emaciation are not very marked, and increase very slowly. In such cases the internal organs show no clinical signs of abnormality whatever. The joint condition progresses slowly and gradually for a number of years, may remit occasionally or become quiescent, and after a variable amount of crippling the patient finally succumbs to some intercurrent malady. In the severest forms, the joint condition progresses rapidly and the cachexia, emaciation, etc., become extreme; and when the external conditions are unfavorable the individual, after a few years of suffering, becomes marantic and dies. Between the mild and the extreme cases there are all grades. In another class of cases, there is a slight rise in temperature in the beginning which remains, with slight remission, continuous for a long time. In these cases the joint condition differs in nowise from that in the cases without fever, and the joint disease continues to progress in the afebrile stage. This, aside from the fact that the joint disease begins insidiously, readily differentiates these cases from the poly-articular infection in which the progress of the joint condition always subsides with the subsidence of the temperature and constitutional disturbance.

Increased pulse rate, even tachycardia, is not an uncommon symptom in both the febrile and the afebrile cases. It is sometimes severe enough to be apparent to the patient, who then complains of palpitation. Such individuals are apt to be, but not necessarily, troubled with symptoms of functional nerve derangement. In some

there is only slight nervousness, but in others there is marked irritableness, abnormal anxiousness, and insomnia. But nervous irritability and functional nervous troubles generally are not particularly characteristic of those with increased pulse rate; such symptoms are common in metabolic osteo-arthritis without tachycardia. That intelligent people who are helplessly crippled should become hypochondriacal is not surprising, and does not imply, as some observers would have it, a definite derangement of the higher nerve centres.

Muscular atrophy of a more or less general nature is a marked and constant symptom in osteo-arthritis. To a large extent it can be ascribed to the general emaciation and the causes, whatever they may be, which usually cause this condition in other joint diseases. But in many cases it is so extreme and manifests itself by weakness so early (even before there are perceptible changes in the joints), that it seems not unlikely that other factors besides are influential in its production. In nearly all cases the reflexes are exaggerated. This is to be expected along with other functional nervous derangements. Of a much more specific character is fibrillar contraction which occurs in many cases. This symptom is present when the disease is well advanced, and manifests itself when the muscles are at rest and in action.

According to numerous French observers skin lesions are common in patients suffering from metabolic osteo-arthritis. But from my own observations, which are in accord with those of Pribrim, I have not, with one exception, found them more frequent than one could expect in otherwise normal individuals. Trophic conditions of the nails are occasionally present, but they are not distinct or frequent enough to be considered characteristic. Glossy skin, spoken of by some authors as a characteristic symptom, must be rare, for I have not seen it once in an undoubted case of metabolic osteo-arthritis. On the other hand, I have seen it several times in severe polyarticular infectious osteo-arthritis, and for this reason I think many if not all the cases reported must be based upon a faulty diagnosis. The same seems to be true of the so-called rheumatic nodes. In none of the cases of joint disease I have seen, in which nodes were present, was the joint condition metabolic osteo-arthritis.

Œdema and even scleroderma have been reported. The scleroderma I have not seen; it must be a rare condition, but in a number of cases œdema was present. In these instances I have had the impression that the œdema which occurs in patients without cardiac or kidney lesions, was similar if not analogous to that which occurs in certain neuroses.

A very peculiar and interesting condition of the fingers occasionally presents itself in these patients. The abnormality appears to be due to some change in the skin, and for this reason is discussed under this heading; but in reality it is due to atrophy of the bones and subcutaneous tissues, the skin remaining intact. In consequence

the skin hangs loosely over the fingers, and in severe cases the effect of a worn glove is strikingly reproduced. Some authors have considered this condition to be due to an œdema which, after stretching the skin, has disappeared; but as I have known it to occur in cases in which no œdema had been present, for this as well as other obvious reasons, this explanation is more than improbable. Moreover, in just such cases the extreme atrophy of the bone can be demonstrated by the *x*-ray pictures.

Since the theory of uric-acid intoxication has been abandoned, there remains little to be said regarding the condition of the urine in cases of metabolic osteo-arthritis. So far nothing characteristically abnormal has been found. In the terminal stage of the disease, in children, albumin is present in some cases. It is absent in the majority of the cases, however, and its relation to the condition, if there is one, has not been ascertained.

In children, metabolic osteo-arthritis occurs in connection with two apparently distinct constitutional conditions. One exactly corresponds with that of the afebrile type in adults. The other is a very characteristic condition which, with some evidently different conditions, is known as Still's disease. In 1897 Still described what he considered a characteristic joint disease of early childhood, which manifested itself by the gradual onset of more or less symmetrical joint swelling, enlargement of the glands and the spleen, and fever. According to Still, the disease is progressive and gradually involves all the joints of the body. Since then, all cases of polyarticular joint swelling with fever and glandular enlargement have been designated Still's disease. Now, as has been indicated, certain forms of polyarticular infection in children are characterized by polyarticular nodular swelling, which may or may not be symmetrical. In these cases there is often glandular swelling, and sometimes the spleen is also enlarged and palpable. These cases are usually called Still's disease. Whether it is proper to call them so remains for Still to say, for he considers the condition that bears his name infectious.

It is certain, however, that these cases differ radically from a definite condition occurring in children, in which the joint disease, whatever the general condition, is certainly not infectious. I have seen ten such cases with two autopsies. The joint changes are purely degenerative and correspond exactly with those of adult forms of metabolic osteo-arthritis. Of course, owing to the preponderance of the cartilage in young children, the bone changes are not so definite and cannot be made out in radiograms.

The disease comes on insidiously, symmetrically involves the peripheral joints first, thence gradually proceeds to those of the trunk, and finally all the joints of the body become affected. In these cases there is very little or no pain, and the children rarely complain of it, unless compelled to walk or are roughly handled. There is moderate but general glandular enlargements. Not only the glands in the

neighborhood of the affected joints are involved, but all the glands take part in the process; and at autopsy I have found decided swelling of the bronchial and mesenteric glands. The spleen is invariably enlarged and palpable. At times the liver is also enlarged, and in some cases extends far down below the free border of the ribs. (Fig. 15 shows a child in whom the liver and spleen are so large that although there is no ascites, the abdomen is markedly protuberant.) There is a moderate continuous temperature, with secondary anemia and cachexia.



FIG. 15.—Case of metabolic osteo-arthritis in a boy. (The hand is shown in Fig. 4.) The liver and spleen are so large that they cause marked protuberance of the abdomen.

Whether Still includes cases of this nature with the polyarticular infections, I cannot quite make out. In the conditions I have outlined above, the fingers were always involved; this does not seem to be so in the cases reported by Still and others.

From the study of the general symptoms, it is evident, that while the joint condition remains uniform, the constitutional symptoms vary within wide limits. It is quite improbable that a primary uniform joint disease should be responsible for such variable general

symptoms, much less such totally distinct constitutional conditions as, for instance, the two forms which occur in children. We may, then, without resorting to further argument, conclude that the joint disease is not a primary local condition causing secondary general symptoms. The next question to decide is, Is the joint condition secondary to some specific general abnormality. That there is some morbid condition which affects the metabolic processes is evident; the cachexia, the effect upon the nervous system, upon the heart (tachycardia), and even upon the vascular system (for vasomotor disturbances have been observed in a number of cases), the symmetrical and progressive character of the joint lesions all speak for this. However, although it cannot be denied that some metabolic disturbance is responsible for the joint and some of the other symptoms, this does not necessarily prove we are dealing with a uniform and specific general disease as a cause.

On the contrary, the variability of the general symptoms plainly indicate that this cannot be the case. Indeed the fact that perfectly typical cases of metabolic osteo-arthritis are known to occur in the course of widely differing diseases, plainly indicates that the constitutional condition, whatever its relation to the joint condition, may owe its presence to totally distinct and opposite morbid influences.

Whatever may be the case with the other skin diseases, it is certain that individuals who suffer from psoriasis show a marked tendency to have trophic joint disease. And although the lesions in such cases are not always typical metabolic osteo-arthritis, so many of them are that we must conclude, as was suggested in one of my previous papers, that the two conditions are in some way related. Their relation to each other or to the common cause need not again be discussed. That the pathogenesis and cause in cases of metabolic osteo-arthritis with psoriasis is different from that of metabolic osteo-arthritis without this skin lesion seems a reasonable conclusion. For it is quite unlikely that a given pathogenic factor should directly produce such a typical skin lesion in one case, and be present in another without causing such lesions.

Basedow's disease is another distinct disease in the course of which metabolic osteo-arthritis may develop. In this instance the relation to metabolic osteo-arthritis has been erroneously interpreted in a number of cases reported. So-called rheumatoid arthritis and Basedow's disease have been thought to co-exist, when, as a matter of fact, the Basedow followed a general infection with joint symptoms (infectious polyarthritis or osteo-arthritis). What I refer to here, however, are typical cases of metabolic osteo-arthritis, which come on in more or less typical examples of exophthalmic goitre. I have seen two such cases. In a third case, besides the typical joint disease, there were exophthalmos, large liver, spleen, and glands, with tachycardia. A similar case has been reported by Dr. Manges.²

² Mt. Sinai Hospital Reports, vol. i.

That tachycardia and nervous symptoms occur in connection with metabolic osteo-arthritis was, I believe, first pointed out by Spener; and the similarity of these symptoms with those of Basedow's disease has since been suggested by a number of authors. Besides a number of cases with typical Basedow and typical metabolic osteo-arthritis have been reported. Here, again, the constitutional symptoms vary greatly. From the cases previously referred to, in which there is simply increased pulse rate, to the cases with distinct tachycardia, exophthalmos, large thyroid (typical Basedow's), there are various grades of constitutional disturbance suggesting this condition.

Still more striking, however, is the fact that typical metabolic osteo-arthritis may occur in the course, and apparently as the result of pulmonary tuberculosis: not that the conditions generally spoken of as tuberculous rheumatism are always cases of this joint disease, for all forms of joint disease due to direct infection, acute toxemia, and trophic conditions have been so designated. As far as trophic or degenerative conditions of the bones and joints are concerned, three distinct forms occur with pulmonary tuberculosis; these are: (1) Monarticular forms of trophic osteo-arthritis (senile type). (2) Hyperplastic peri-ostitis or ostitis (osteo-arthropathie hypertrophique pneumique, Marie) (so-called club fingers). (3) Metabolic osteo-arthritis. That so many diverse conditions should occur under these circumstances, is not surprising when it is considered that the tubercle bacilli secrete no toxin, but cause toxemia or general disturbance because of the disintegration of the tubercle bacilli themselves. As the tubercle bacilli are complex bodies, it is to be expected that their disintegration and absorption should cause variable symptoms and conditions.

It is plain, then, that metabolic osteo-arthritis occurs not only in individuals who present variable constitutional symptoms, and, therefore, no doubt have variable constitutional abnormalities, but it also occurs in the course, or as the result of totally distinct and well-recognized diseases. Hence it cannot be due to a distinct and uniform general disease.

Nor to judge from the totally distinct character of the morbid conditions with which it is associated, can it be due directly to the various causes which induce these conditions. For it is quite unreasonable to suppose that a morbid condition like that due to the tubercle bacillus, which either causes changes due to direct invasion or to a toxemia, which necessarily involves some irritation (degeneration with proliferation, or even inflammation), should in certain isolated examples induce such a purely atrophic degeneration as occurs in metabolic osteo-arthritis; still less so, that such a pathogenic factor should directly induce the same pathological changes, as do others so totally different, as those which are responsible for the other conditions with which metabolic osteo-arthritis is known to be associated.

The only reasonable supposition is that all these conditions are active in producing an analogous general disturbance of the organism which in turn causes the joint degeneration. Indeed, it has been suggested that a general nervous derangement is the cause of it. But this cannot be true, because derangements of the nervous system, diseases of the spinal cord or the brain, or peripheral nerve lesions do not cause conditions like metabolic osteo-arthritis, but others, such as trophic osteo-arthritis of the senile type.

On the other hand, differing as they do in their origin and nature, the conditions, known or unknown, with which metabolic osteo-arthritis is associated, all have one thing in common. This is their deleterious influence upon the general nutrition. It matters little in what way this influence is exerted, as far as the tissues are concerned; upon them the result is the same, viz., inadequacy of the nutrition. In metabolic osteo-arthritis, the joint condition, a pure atrophic degeneration, exactly corresponds to what one would expect under such circumstances.

As a matter of fact, if we can rely at all upon the principle of general pathology, the changes which are typical of this condition could only be caused by a purely nutritive anomaly. Hence the conclusion that metabolic osteo-arthritis is due to a metabolic derangement which seriously impairs the joint nutrition is inevitable.

Whether or not the vice of the metabolism is of a peculiar kind, it is impossible, in the present state of our knowledge, to say. It is certain, however, that no toxic substance in the circulation can directly cause the joint changes. If a toxemia or auto-intoxication is present, its toxic effect is not exerted upon the joints directly, but indirectly through the impaired nutrition. All the toxemias, acute and chronic, with which we are familiar, when they act directly, induce similar changes in the bones or joints. When they act acutely they cause acute inflammation; when chronic they cause hyperplastic periostitis or osteitis or degeneration with proliferation in the joints (toxic polyarthritis or osteo-arthritis of the senile type).

But if the joint condition is purely one of the nutrition, it might be asked, Why should the joints and bones alone be involved? This question is readily answered. In the first place, the bones and joints are not the only tissues involved. In the severe forms the tissues in the neighborhood of the joints are appreciably atrophied. There is general emaciation and secondary anemia. The general musculature is markedly atrophied. That the internal organs show no changes is by no means certain; they have never been carefully examined. Finally, the fact that the bones are so strikingly involved, is not at all surprising when it is remembered that the bones are unusually sensitive to changes in the general nutrition as, for example, the marked bone changes in rachitis, the atrophy of senility, and even physiological conditions, the bone softening in puberty, juvenile osteo-arthritis, lateral curvature, etc., and the osteomalic changes in pregnant women.

From the study of metabolic osteo-arthritis here undertaken we are justified in drawing the following conclusions: (1) Metabolic osteo-arthritis is a distinct pathological condition of the joints, which can easily be recognized clinically; (2) it is not, however, a primary joint disease causing secondary general symptoms; (3) nor is a uniform specific general disease responsible for it; (4) it occurs in connection with a number of distinct clinical conditions, some of which are known to be specific diseases; (5) the joint disease is not due directly to the conditions with which it is associated, but is due to their deleterious influence upon the general nutrition.

How the metabolism is affected or what changes it undergoes has not been determined. What is certain, however, is that the changes in the joint are passive: simply an atrophy which can only be induced by inadequacy of the nutrition.

For these reasons the joint disease here discussed has been grouped with the nutritive or trophic joint diseases. In order to distinguish it from those conditions which cause local changes only it has been termed metabolic, and to distinguish it from the rather uncommon metabolic conditions which cause synovial changes only, it has been called osteo-arthritis.

Thus, metabolic osteo-arthritis is a chronic osteo-arthritis due to a vice of the metabolism caused by a number of conditions, organic or functional; insidious in onset; symmetrically involving new joints toward the trunk, it gradually leads to more or less deformation and crippling. The x-rays shows circumscribed bone rarefaction in the early stages, and a more or less complete absorption of the epiphyses in the later stages, but never proliferation or bony ankylosis. Pathologically, beginning in the bone, there is a pure atrophic degeneration of all the joint structures.

TREATMENT. Up to the present time the prognosis in metabolic osteo-arthritis was considered hopeless as regards the recovery from the joint condition. To be sure, it was known that in certain cases the disease became quiescent; but no consistent effort to improve the condition, as far as I know, has been successful. These individuals are among those who have spent their time visiting one resort after another without deriving benefit from any. Cures have been reported, but those who recovered were evidently not suffering from metabolic osteo-arthritis.

In reporting results of treatment in these cases, the *sine qua non* is the diagnosis. To say one has cured a case of rheumatoid arthritis is to say nothing at all—for the case may have been one of infectious polyarthritis which could have recovered without specific treatment of any kind. So in the cases, to speak only of recent examples, reported by Hoke and Andrews, which are said to have been cured by the use of kifolac. These cases comprised all forms of joint disease, monarticular, polyarticular, trophic, and infectious, so that these statistics are practically useless. Whether or not kifolac is

useful in metabolic osteo-arthritis, I have not been able to determine. In the few cases I have seen which were treated with it, I could see no improvement; but these cases were not in my own care, and apparently were not systematically treated. On the other hand, I have had uniformly good results with the use of thymus gland extract.

Some years ago I began to use it, because of the influence of the thymus upon the development of the bones, as was shown by Basch³ in his experiments upon animals. I first used it in children in whom I found it had a very remarkable effect. In children with the metabolic osteo-arthritis with large glands and spleen, the joint disease soon became quiescent, and children who had not been upon their feet for from six months to over a year were again able to walk. That the restoration was due to the thymus and not to natural causes, was proved by the fact that the joint symptoms soon returned when the gland treatment was omitted. Good results were also obtained in children without glandular swelling, and in adults. In adults the effect upon the general nutrition is very marked. Patients who are extremely emaciated soon begin to take on flesh, and the muscular power is greatly increased. In the earlier stages of the disease the improvement is more rapid and definite. In the later stages large doses must be continued for some time before there is apparent benefit.

Of course it is quite hopeless to attempt restoration of joints which have been more or less completely absorbed. But in these cases the improvement in the general condition and increased weight is of decided benefit to the afflicted individual. In long-standing cases muscular contraction continues even after all joint symptoms have subsided. Such muscles have been permanently shortened, and the deformity so caused must be corrected by tenotomy. To attempt to stretch these tendons is dangerous, because such efforts are more likely to result in the fracture of the softened bones than in the stretching of the tendons. I have seen this accident a number of times.

My method of proceeding in these cases is as follows: The thymus is given immediately. I usually begin with two 5-grain tablets, thrice daily. In two weeks the dose is increased to three tablets, and after a few months three tablets four times a day are given. The patient is kept at rest until all symptoms of active joint disease have subsided. I then begin passive motion in all the affected joints. This is carefully done at first and gradually increased until I have an arc of free motion which is only limited by the shortened tendons. Massage, which is often painful, is unnecessary and may even be harmful. My next step is to get the patient on his feet. This is sometimes a tedious affair; for patients, particularly adults, are

timid at trusting themselves at first. But by persistence the patient eventually gains confidence, and finally is able to get around as well as deformity in the lower extremity will permit. I have found it much more satisfactory, when I have the proper assistance and the patient the means, to take them into a private institution whilst they are learning to walk. Public hospitals are not suitable, because in them there are neither the trained assistants nor the time for this kind of work. A persevering intelligent mother can usually do more with a child than anyone else.

As soon as the patient is able to be upon his feet or use his joints without the appearance of joint irritation, all contracted tissues are divided with the tendome and the deformity is corrected. This, of course, requires immobilization for three or four weeks; but with light plaster-of-Paris bandages it does not preclude the use of the lower extremities. A few days after the operation the patient is again induced to be about, and he is usually able to hobble around quite comfortably with crutches or a cane until the bandages are removed.

With such treatment all but the most severe cases, which have existed for a long time, can be definitely improved. Often the patients recover sufficiently to be about and attend their avocations. The treatment, however, requires patience, a definite knowledge of the condition, and time; without these only in the very mild cases can one be successful.

It must not be supposed that I consider the thymus extract a specific for the cure of this condition. The nature of the disease, as it has been enunciated in this communication, precludes such an idea. Moreover, the fact that in children the enlargement of the glands, liver, and spleen is not at all affected, although the joint condition is markedly improved, shows conclusively that its action is not specific, as far as the original constitutional condition is concerned. The thymus acts simply as a stimulant to the nutritive processes, and probably in a measure counteracts the deleterious influence of the causative condition.

In conclusion, I take pleasure in thanking the following gentlemen for the use of clinical material: Dr. W. R. Townsend, Dr. V. P. Gibney, of the Hospital for Ruptured and Crippled; Dr. E. Libman and Dr. M. Manges, of the Mt. Sinai Hospital; and Dr. Albee and Dr. Cole, for x-ray work done for me. The majority of my cases were seen outside of hospital practice, and I am indebted to many of my medical friends for referring them to me.

PRIMARY SPLENOMEGALY OF THE GAUCHER TYPE.

A REPORT ON THE SECOND OF FOUR CASES OCCURRING IN A SINGLE
GENERATION OF ONE FAMILY.

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WHEN our report of the pathological conditions found in one of the fatal cases of the family suffering from primary splenomegaly of the Gaucher type was published in March, 1905,¹ we were working at the organs of the sister of the patient who formed the subject of our report, and had promised to publish the pathological findings in this second case. After many delays we have finally succeeded in bringing our findings to publication.

The clinical histories of these two cases have been recorded.² The history of the second case may here be succinctly continued to the time of her death in September, 1904: Increasing anemia, increasing emaciation, increasing enlargement of the abdomen due to enormously increasing size of the spleen and liver were noted. Outside of a fracture of the third and fourth ribs on the right side, due to a fall in 1902, the patient was never confined to her house. These fractures healed without delay, with a large amount of callus. There were infrequent attacks of epistaxis, more frequent attacks of bleeding from the gums. Occasionally melena was noted, and on numerous occasions the feces gave positive reactions to the guaiac test. Ecchymoses occurred in the skin after the slightest injury. Pains referable to the ends of the femur and tibia were often complained of, but nowhere could bone tenderness be elicited. Sweating and hemorrhagic sudamina became more frequent. The brownish, uniform discoloration of the skin of the face and hands deepened. The hemoglobin gradually diminished to 35 per cent. (Dare instrument), although the red blood count at its lowest was 3,500,000. The white blood count still showed a tendency to leukopenia, the count being 3600 to 5200; no qualitative changes. There were no evidences of jaundice. Bile was absent from the blood serum and urine; the latter contained no urobilin.

Notwithstanding the apparently wretched appearance of the

¹ Primary Splenomegaly, Gaucher Type. Report on One of Four Cases Occurring in a Single Generation of One Family. AMER. JOUR. MED. SCI., March, 1905.

² AMER. JOUR. MED. SCI., April, 1901, and March, 1905.

patient, which suggested a very serious illness, she showed an almost ceaseless activity, attending to domestic and social functions. She made no complaint of feeling ill outside of complaining of dyspnoea. On September 12, 1904, on crossing the street she was hit by a bicycle, which suddenly rounded the corner of the street, and knocked down, sustaining a fracture of the skull and laceration of the brain, from which she died that night.

Postmortem examination, September 13, 1904 (seven hours after death). Body length 155 cm. Marked emaciation; rigor mortis marked. Petechiæ in left conjunctiva, with large hemorrhages under the conjunctiva at the outer canthus. Hemorrhages are also present in the skin of the upper lids on both sides. No jaundice. Diaphragm on the right side at the second space; on the left side at the second rib. Cervical lymph nodes perceptible; axillary nodes not palpable; inguinal nodes perceptible. Small amount of clear, reddish fluid in the abdomen. Marked adhesion of the spleen to the abdominal wall and omentum. The spleen almost fills the entire abdominal cavity, extending about two fingers' breadth below the level of the superior spines of the ilium on both sides. The liver is adherent to the anterior abdominal wall. The small intestines lie below, behind, and to the right of the spleen. The stomach lies between the liver and the spleen, on the right side of the abdomen, the pylorus being situated posteriorly.

Over the occiput is a large hematoma, about 1.5 cm. thick and 7 cm. long. The brain is lacerated on the inner aspect of the frontal convolutions of the right side. Beneath the pia mater on the median surface of the right hemisphere is a large amount of blood. An extensive hemorrhage is also present over the entire external surface of the left hemisphere, and an extensive laceration of the left temporal lobe and third left frontal convolution is seen. The middle third of the median aspect of the right hemisphere is also lacerated. The line of fracture extends from the right posterior lacerated foramen across the transverse sinus to a point 2.5 cm. above and 2.5 cm. to the right of the torcular.

The heart weighs 215 grams. Fairly firm bands between visceral and parietal pericardium. Wall of right ventricle 0.5 cm. thick; left ventricle dilated, wall 1.25 cm. thick; right auricle dilated. Mitral valve slightly thickened, ring somewhat calcareous; aortic valve slightly insufficient (water test); some retraction of the flaps and thickening of their lines of attachment. Slight atheroma of aorta and coronaries. No congenital lesions. Heart muscle is brown in color. The lungs are non-adherent; fairly well expanded; anthracosis; moderate congestion. Bronchial nodes slightly enlarged and anthracotic. The spleen measures 45 x 25 x 13 cm.; and weighs 8.1 kilograms. There is recent and old perisplenitis. The pulp swells above the level of the cut surface. The color, as a whole, is salmon pink with grayish markings. There are no evidences

of Malpighian bodies. Scattered throughout the spleen are large and small elevated areas which are firmer than the main bulk of the tissue. Most of these are red in color, with grayish and yellowish markings; a few are reddish at the margins and yellow at the centre. Besides these, a number of large, yellow, cheesy areas are seen, a few of which are very soft and are surrounded by a capsule. Splenic artery negative; splenic vein atheromatous. Near the hilum are a few small masses of accessory splenic tissue, pale yellowish in color. The liver is irregularly quadrate in form, very much enlarged; weight 3.9 kilograms. The width is 35 cm.; length of right lobe, 30 cm.; left lobe, 18 cm.; greatest thickness, 12 cm. Old and recent perihepatitis. The parenchyma swells above the cut section, is light brownish in color, with irregular grayish markings. The outlines of the lobules are absent. On the under surface are a number of small hemorrhagic markings. The portal vein and the hepatic veins are negative. The gall-bladder is distended with dark, thick bile, containing a large number of very small, irregularly rounded stones, black in color. The wall of the gall-bladder appears to be normal; the ducts are pervious.

The kidneys combined weigh 270 grams. The right kidney measures 12 x 6 x 3.5 cm.; the left 13 x 7 x 3.5 cm. The left kidney is flattened, its capsule is adherent. The veins of the surface are injected, and a few dark depressions and small cysts are present. The cortex is swollen, and has a yellowish red color. On section the markings are poor; the medullary pyramids are intensely congested. The right kidney shows the same changes as the left, excepting that the medulla is less congested.

The right adrenal is large and flattened, and the medulla appears hemorrhagic. The left shows no changes. The stomach is much dilated; contains curdled milk. The ascending and transverse colon are moderately distended; the descending colon and sigmoid flexure are collapsed. The small intestine presents areas in which the vessels are very much distended and the mucosa swollen. The lymphoid follicles are very distinct and white in color, and especially prominent near the valve. The large intestine shows distention of veins and areas of inflammation, and lymphoid areas similar to those in the small intestine. The pancreas weighs 90 grams. The cut section shows congestion of the veins.

The mesenteric nodes are moderately enlarged; on section they are either entirely yellowish in color or dark red with yellowish markings. The retroperitoneal and iliac nodes, as well as the nodes of other parts of the abdomen, show the same changes as the mesenteric nodes. Some are the size of a pea, others as large as an almond. The iliac nodes are the size of an almond, and on section are either diffusely yellow in color or brownish black with yellow markings. The uterus is atrophic and virginal. There is an old hemorrhagic area in the right ovary, and remains of corpus luteum. The bladder shows

injection of the vessels. The marrow of the vertebræ is normal. The cavity of the femur is filled with soft tissue which is dark red in color, with some yellowish areas.

Microscopic Findings. It may be stated at the outset that the lesions found in this case do not differ materially from those described in our first case, excepting that the changes in some of the organs are more advanced, as a result of the longer duration of the disease.

Spleen. The necrosis in this organ is very advanced. A study of the necrotic areas shows that the nuclei of the characteristic endothelial cells disappear somewhat earlier than the protoplasm. Large masses of endothelial cells are found, whose contours may still be

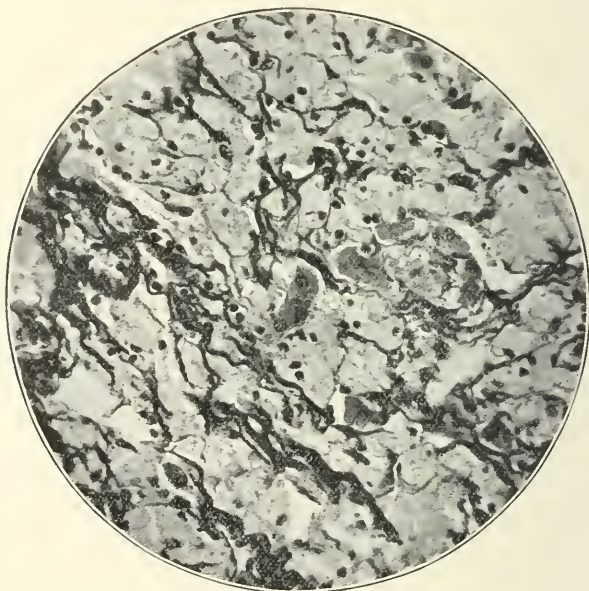


FIG. 1.—Section of the liver, showing endothelial cells in the meshes of the interlobular connective tissue. In the centre of the field are a few normal liver cells. (Photomicrograph $\times 250$.)

recognized but whose nuclei are absent. Surrounding these necrotic areas are cells in which degenerative changes are apparent but in which the nuclei are regularly seen. A few capillaries are present in the necrotic areas, and small collections of pulp cells may be noted here and there. The hemorrhagic areas in this case are very extensive and are found in nearly all of the portions examined. More pigment is seen in this than in our previous case, and many of the cells are literally crowded with pigment granules. The distribution of the pigment is the same as in our earlier case, though here and there a few small particles are seen in the endothelial cells lining the capillaries. With these few exceptions, the sections present the same appearances that were described in full in our first case.

Liver. The endothelial cells are very abundant in this organ and easily seen. As a rule, they are situated in the meshes of the interlobular connective tissue (Fig. 1), but a large number are also present in the lobule proper. In this situation they lie between the liver cells, without exerting any apparent pressure effects upon the latter (Fig. 2). With the low power the picture is that of a cirrhosis. A few of the characteristic endothelial cells are seen in the lumen of one large vein in the interlobular connective tissue. The pigment is the same as that described in our former case.

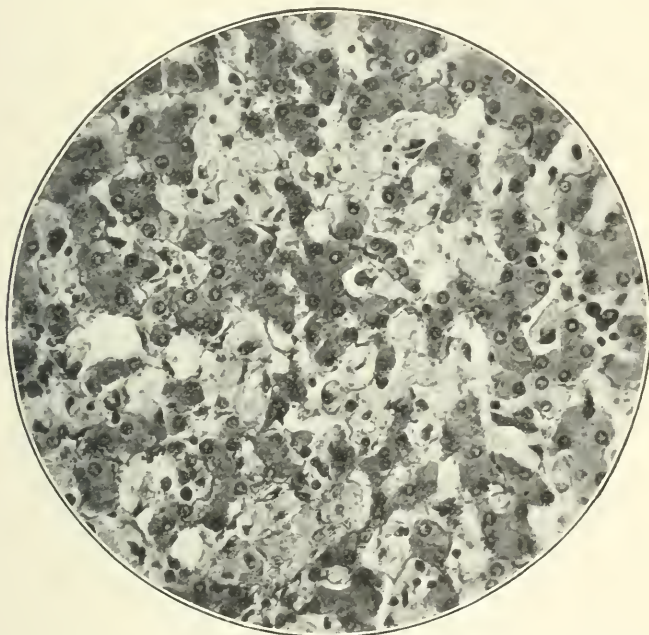


FIG. 2.—The centre of a liver lobule, showing a large number of endothelial cells lying between normal liver cells. (Photomicrograph $\times 250$.)

Lymph Nodes. All of the nodes examined show the presence of a large number of endothelial cells, marked fibrous changes, and a great decrease or entire absence of adenoid tissue. The pigment is very abundant, confined, as a rule, to the sinuses bounded by the capsule and trabeculae, and is crystalline in character for the most part. Chronic congestion is noted in all of the lymph nodes, but no hemorrhages are seen. Sections from the iliac nodes show by far the greatest amount of pigment as well as fibrosis, and almost complete absence of adenoid tissue. A careful study of the pigment in the iliac nodes shows that it is situated almost wholly in the endothelial cells throughout the entire node (Fig. 3). From one to four or five crystals are seen in each cell, the cytoplasm showing faintly

between the adjacent crystals. Wherever the cytoplasm is invisible, the pigment crystals are still arranged in a more or less circular form, showing that they are contained in, and limited by, a spherical body (Fig. 4). In these nodes the endothelial cells are undoubtedly acting as phagocytes.

Bone Marrow. The endothelial cells are much more numerous than in our earlier case; in fact, some sections show hardly any remnants of normal marrow tissue. Other sections present a few islands of marrow cells here and there. The endothelial cells are compressed and distorted, as a rule, and a delicate connective-tissue

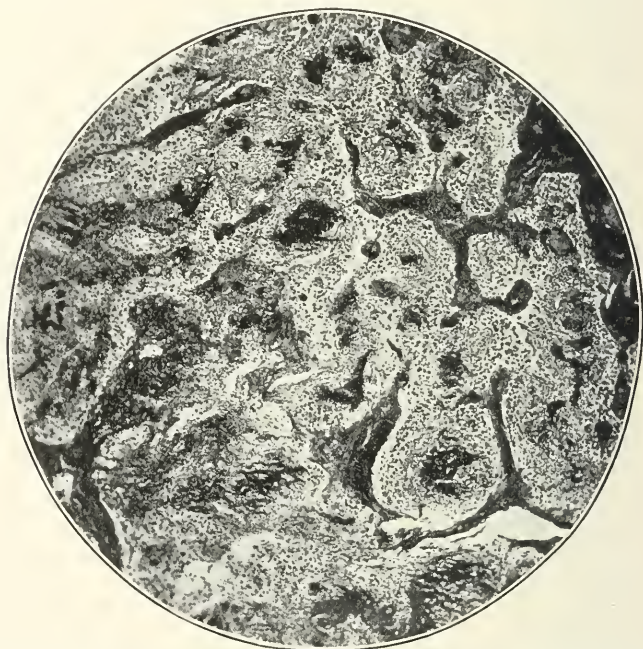


FIG. 3.—Section of an iliac lymph node, with complete absence of adenoid tissue. The entire section consists of connective-tissue reticulum and endothelial cells, the latter being filled with pigment crystals. (Photomicrograph $\times 45$.)

reticulum is seen between them. A few large bloodvessels are present, also numerous capillaries. In one of the latter a distinct and typical endothelial cell is seen. The pigment is not abundant; when present, it is always situated in the immediate vicinity of the larger bloodvessels. The lesions in the other organs are not important, and have no bearing on the disease.

REMARKS. Since the publication of our first case, in March, 1905, two more cases of splenomegaly of the Gaucher type have been recorded. One case was demonstrated by Schlagenhauser³ at a

³ Virch. Arch., 1907, clxxxvii, 125.

meeting of the German Pathological Society, September, 1906. The patient was a female, aged forty-one years, whose mother had suffered from tuberculosis thirty years ago. There were eight children, all of whom were healthy excepting one sister, who had an enlarged spleen. The patient had a "large abdomen" when five years of age, and at the age of twelve a large spleen was diagnosticated. Pigmentation of the face was noted nine years later. Examination of the blood showed hemoglobin, 65 per cent.; red cells, 4,700,000; leukocytes, 1300; the differential count was normal. Death was due to an acute cholangitis. Postmortem examination showed the following:

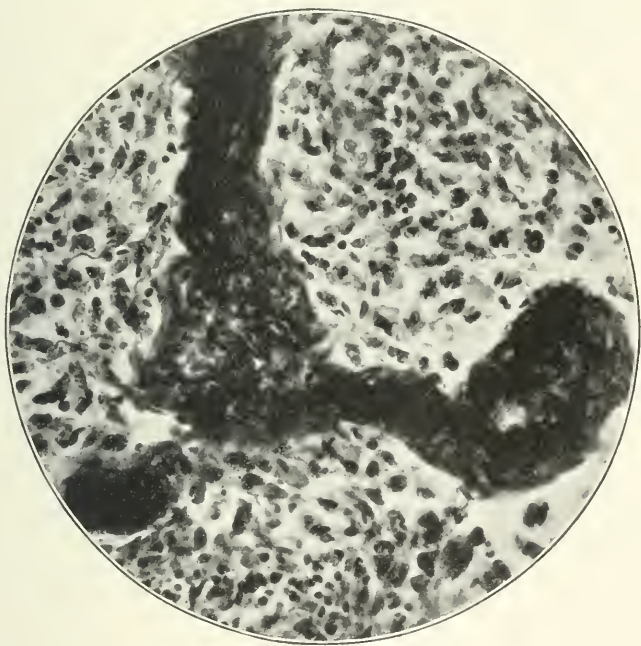


FIG. 4.—The same section shown in Fig. 3, showing the pigment crystals arranged in circular form or contained in endothelial cells. (Photomicrograph $\times 250$.)

Skin of face and extremities yellow; face pigmented; icterus; right submaxillary glands enlarged and necrotic; no ascites. The spleen weighed 3510 grams, was of normal shape, reddish gray in color, and was studded with many nodules. The liver weighed 3000 grams. In the right lobe were multiple abscesses, in the left lobe several nodules. The mesenteric glands were large. The bone marrow was succulent in character and of a reddish color.

Microscopic examination of the spleen showed the usual picture found in the Gaucher type of splenomegaly. The pigment in certain situations, especially in the endothelial cells of the capillaries, did

not give the iron reaction, while the pigment surrounding the blood-vessels gave the usual reaction. Tests for amyloid and fat were negative. Cultures showed the colon bacillus. Smears made from the necrotic parts showed tubercle bacilli, but these could not be demonstrated in sections. Guinea-pigs inoculated with necrotic portions showed tuberculosis. Sections from the lymph nodes showed the typical picture of splenomegaly; the submaxillary nodes contained tubercles. The right lobe of the liver was the seat of acute cholangitis with multiple abscesses; tubercles were found in both lobes. The bone marrow presented the usual picture found in these cases, together with the presence of tubercles.

Schlagenhauser believes that splenomegaly is a systemic disease analogous to lymphosarcoma, excepting that the reticulum is involved and not the cellular structures. Furthermore, he doubts the endothelial origin of the characteristic cells, and considers that they arise from proliferated reticulum. He also believes that tuberculosis may have an important bearing on the etiology of the disease.

In the discussion that followed the presentation of this case, Schridde was of the opinion that the cells are endothelial in nature, and called attention to the fact that such cells are found normally in the spleen and lymph nodes, but not in the marrow.

Sternberg believed that in certain individuals these cells might be present normally in the bone marrow, and if so, would then proliferate in the presence of this disease. Two years before, he had described a proliferation of these cells in the lymphatic hemapoietic apparatus occurring in certain forms of tuberculosis, and had noted these cells in the bone marrow. Sternberg also criticised the parallel drawn by Schlagenhauser between splenomegaly and lymphosarcoma: (1) Because splenomegaly is undoubtedly a congenital disease, which lymphosarcoma is not; and (2) because lymphosarcoma shows malignant characters, in direct contrast to the course of splenomegaly.

The second case was reported by Marchand⁴ in March, 1907. The patient was a woman whose age is not mentioned. A splenic tumor had existed for twenty years, and the liver was also enlarged. A tendency to hemorrhage was present; the skin was icteric and had a brownish color; no leukocytosis. Banti's disease was diagnosed. At the autopsy the spleen weighed 2720 grams; the color was grayish red; scattered nodules were present, some of which were necrotic; no follicles could be seen. The liver was also enlarged (weight not given), and whitish streaks were noted between the lobules. The lymph nodes in the abdomen were enlarged and pigmented. The bone marrow was pale reddish gray and contained grayish white spots. Microscopic examination revealed the characteristic cells in the spleen, liver, lymph nodes, and bone marrow.

⁴ Münch. med. Woch., 1907, liv, 1102.

Marchand examined these organs in the fresh state and calls attention to the peculiar homogeneous, glassy, or hyaline appearance of the cells, similar to amyloid. Sections treated with osmic acid gave no reaction for fat. He does not look upon the process as a simple hyperplasia of the protoplasm, but believes that some foreign substance of unknown nature has been produced in the cells. This substance, when treated with the ordinary reagents employed in histological methods, reacts in a peculiar manner, and causes the streaked and wrinkled appearance of the cells noted, together with the formation of vacuoles and granules. According to Marchand, these cells may arise either from the reticulum or from endothelium.

From a study of our own cases, and a review of those published by others, we can state the following:

Splenomegaly (Gaucher type) is a distinct disease, starting in early life, often affecting several members of a family, and running a chronic course. It may be recognized by a great enlargement of the spleen, which precedes a similar enlargement of the liver, and is unaccompanied by jaundice or ascites; by the discoloration of the skin, especially where exposed to light; and by the absence in the blood of any characteristic findings. The disease has none of the characteristics of malignancy, and usually terminates as the result of an intercurrent affection. The organs affected are the spleen, liver, lymph nodes, and bone marrow. Histologically these organs show the presence of large cells with small nuclei and a peculiar hyaline cytoplasm, which arise from the endothelium or normal reticulum, and the presence of pigment containing iron. The etiology is unknown, though a peculiar susceptibility of the endothelium or reticulum of the hemapoietic apparatus to some unknown toxic agent is most likely present. There is nothing in our cases even suggesting tuberculosis. We would say that when found in cases of this disease, it must be considered as a superimposed process.

PRIMARY CARCINOMA OF THE LUNGS.

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PRIMARY carcinoma of the lungs, although not as rare as it is considered, and not as often diagnosed as it might be, still warrants the reporting of every case that has been carefully studied both clinically and microscopically.

The author's patient was a male, aged sixty-four years, a German, and an insurance agent by occupation. Two of his brothers and one sister died of "galloping consumption," but no member of his

family had had carcinoma. His personal history was negative. He drank and smoked moderately and denied having had any venereal diseases. He had all the diseases of childhood, and at the age of twenty-eight, while in the army, he suffered from enteritis and had several attacks of acute articular rheumatism. He was admitted to the service of Dr. I. Adler at the German Hospital on November 18, 1906.

Up to a year previous to his admission he was perfectly well. After that his general health and strength began to fail. He lost 95 pounds in one year (formerly 245 pounds, now 150). Six weeks before admission he began to have severe cough, with very profuse mucopurulent expectoration; frequently his sputum was streaked with blood. He had very frequent night sweats, and often felt feverish. He had no chills, and never suffered from dyspnoea. He had no pain. His appetite was poor and his bowels were constipated.

On admission the patient was fairly well developed. The body was very much emaciated, the skin very dry. The eyes, ears, and nose were normal. The throat was red and inflamed. There was no glandular enlargement. The chest was broad and barrel-shaped; suprasternal, supraclavicular, and infraclavicular spaces were sunken. The right side above the fourth rib was considerably depressed, and amplitude of respiratory excursions was less than on left. There was normal tactile fremitus all over except at the right base posteriorly, where fremitus was absent. On percussion there was flatness on the right side posteriorly below the fifth dorsal spine, and hyper-resonance over the rest of the lung; on the left side there was slight hyper-resonance. On auscultation on the right side below the fifth spine there was very distant and diminished breathing sounds; egophony at level of the fifth spine; over the rest of lung exaggerated breathing. On the left side there was harsh vesicular breathing. This suggested a pleuritic effusion in the right chest. The heart was apparently normal in size, and there were no murmurs. The stomach was dilated; otherwise nothing abnormal was found in the abdominal cavity.

The extremities were normal. Rectal examination was negative. The prostate was not enlarged. The temperature during first days of admission varied between 99° to 100° in the morning, to about 101° to 103° in the evening. The pulse was 110 to 120; the respirations, 24 to 40. The urine contained a faint trace of albumin, had a specific gravity of 1011, and contained no casts and gave no diazo reaction. A blood count revealed: hemoglobin, 65 per cent.; red blood cells, 4,184,000; white blood cells, 12,600; polynuclears, 69.5 per cent.; lymphocytes, 28 per cent.; mononuclears and transitionals, 2 per cent.; eosinophiles, 0.5 per cent. No changes in red blood cells.

These data seemed to suggest a tuberculous pleurisy. The sputum, however, on repeated examination failed to show tubercle bacilli,

but always contained blood, white blood cells, and flat epithelial cells.

November 21. Two days after admission the right pleural cavity was tapped and about 150 c.c. of a bloody, slightly turbid fluid with specific gravity of 1025, was withdrawn, which on microscopic examination showed, besides numerous red blood cells, a slight predominance of polynuclear cells. Cultures of this fluid were sterile. The tapping did not very materially change the physical signs. Instead of absolute flatness, the percussion note was merely dull. The general condition of the patient was so far improved in that cough and expectoration were easier, but his respirations continued rapid.

November 29. Eight days after tapping, the flatness at the base of right lung reappeared, but with it were course crepitant rales, harsh breathing, and bronchial voice sounds, suggesting at the time a cavity in the lung separated from the chest by very thickened pleura. Sputum during this time was examined daily, but there was still no evidence of breaking down lung tissue. The patient continued with temperatures between 100° and 103° F., rapid respiration, cough, sweats, and pain in the right side of the chest until December 13 (three weeks after first tapping), when another exploratory puncture was made. With the needle in the seventh space posteriorly, and only after it was 6 cm. deep, was a thick brownish yellow pus obtained. Cultures were sterile. It was apparent now that we had either an abscess of the lung or, less likely, an encapsulated empyema to deal with. The general symptoms did not subside, so the patient was transferred to the surgical division.

On December 20 Dr. Willy Meyer resected the ninth rib, but found that pus came from a narrow channel above, and therefore resected the seventh rib. The abscess cavity was entered with the paquelin, and about four ounces of pus mixed with broken down tissue was obtained. The operator pronounced the cavity to be in the lung substance. The laboratory report of the tissue removed from the abscess was "lung tissue showing compression, congestion, oedema, and consolidation" (Dr. R. Weil). After this operation the high temperatures ceased, but the patient still had severe night sweats, cough, and expectoration. Repeated examination of the sputum showed no tubercle bacilli and no tumor cells, but constant presence of traces of blood. On and off the patient complained of slight pain in the right hypochondrium, but physical examination proved negative. Nothing new developed until

January 31 (six weeks after operation). Then the pains in the right hypochondrium became very severe, and the temperature rose to 104°. There was nothing new in the lungs or the wounds left from the operation to account for this, but just below the middle of the right costal margin in front, there was a distinct tender mass about the size of an orange, which moved with respiration. Fluctuation

was questionable. For several days the patient ran septic temperature, and a diagnosis of "empyema of the gall-bladder" was made. The high temperature gradually subsided.

February 15. Cholecystostomy was performed by Dr. Meyer. About a pint of pus and bile was evacuated and two gallstones, each about the size of a marble, were removed from the gall-bladder. From this operation the patient made an uneventful recovery, but the wounds in the chest healed slowly, the respirations remained accelerated, the temperature was about 100° , and there was still dulness and distant bronchial breathing at right base posteriorly. The patient became tired of hospital surroundings, so on April 1 (four and one-half months after admission) he left, but was to come to the outdoor department for dressing.

June 26. He returned to the hospital. He said that since he left he was able to be about, but he continued to have fever and his wounds in the chest were painful and did not heal. As before, he coughed and expectorated quite a good deal, and after each dressing he would spit up frothy blood. He had not lost much in weight and felt quite strong.

The condition of his lungs was essentially unchanged. There was dulness and rather peculiar distant harsh bronchial-like breathing at the right base posteriorly. The sinuses from the operation for abscess of the lung were not yet healed. Over the right scapula a baseball-like fluctuating mass was found. The axillary, occipital, and clavicular glands were not enlarged.

During his second stay at the hospital the symptoms were about the same as before. He coughed and sweat a great deal at night. Respirations were between 26 and 40, temperature ranged between 99° and 102° , and only occasionally did he complain of dyspnoea. The sputum was examined, but neither tubercle bacilli nor elastic fibres, nor any of the cells described as characteristic for neoplasm were found. Blood was always present.

July 23. The mass over the scapula, having become larger, was excised and found to be "carcinoma." From about this time the patient began to fail rapidly. His weight now was 123 pounds and dyspnoea increased.

September 5. While attempting to leave his bed, the patient collapsed and died from heart failure within five minutes.

The following are the notes of the autopsy performed several hours after death: The body is very much emaciated. Operation scar on the right and left sides of thorax posteriorly. Old scar over region of gall-bladder. Rigor not marked. Slight oedema of both lower extremities. No jaundice, no petechiae, no glandular enlargement. Thorax cartilages of ribs completely ossified. Ribs break quite easily. The pleura on the right side reveals extensive adhesions below and posteriorly. On the left side there are firm adhesions posteriorly. Both sides contain several ounces of clear

serosanguinous fluid. The right leaf of the diaphragm is very much thickened (one-half to three-fourths inch), tightly adherent to the liver and the right lung. On section it has the consistency of cartilage and appears dense, white, and glistening. The left side is slightly thickened. The lower and middle lobes of the right lung are tightly bound together, forming one large, hard, solid mass. The pleural surface is very much thickened and presents two scars which dip downward into the underlying tissue. On section the lung cuts with marked resistance to knife, especially toward the hilum of the lung. On cut surface there is all along the outer margin of the lung a narrow strip (about one-half inch) which is all that remains of apparently normal lung substance. The rest of the lung is grayish white in color, granular, mottled here and there by darker areas, firm in consistency, and apparently made up of small nodules so closely packed together as to give an appearance somewhat similar to diffuse gray hepatization. The small bronchi are prominent. Their walls are thickened. Some have their lumens constricted, others are completely occluded. Few small bronchiectatic cavities varying in size from pea to lima bean are also observed, these being filled with yellowish creamy mucopurulent exudate. The upper lobe shows scattered irregularly throughout it many small, yellowish white, round areas about one-fourth to one inch in diameter, firm in consistency, circumscribed, and intimately associated with neighboring lung tissue. These areas do not have a cheesy appearance, and one cannot scrape any cheesy material from their cut surface. The rest of the lung shows slight congestion, œdema, and some areas of emphysema. At the apex of the left lung there are a few old calcareous tubercular foci and in lower lobe several metastatic nodules similar to those in the upper right lobe. The bronchial glands are very much enlarged, hard, closely adherent to larger bronchi, and on section present a diffuse grayish white appearance. The mediastinal glands are but very slightly enlarged. The supraclavicular and infraclavicular glands are not involved. The larynx, trachea, and bronchi are normal. The heart is dilated, the muscular coat very pale and flabby; there is marked calcific sclerosis of aortic and mitral valves and also of coronary arteries. The aorta contains many stone-hard round plaques and ulcerative areas. The œsophagus and thoracic duct are normal. The abdomen contains several ounces of clear serous fluid. Viscera in situ seem normal. Omental fat almost completely gone. The liver is enlarged and adherent throughout to diaphragm. Surface is irregular; scattered over it are few small, round, whitish nodules elevated above the surrounding liver substance and only slightly umbilicated. These are almost entirely on upper surface. At the falciform ligament there are many of these nodules grouped together, giving a mass about the size of a hen's egg. On section the liver cuts with resistance, and similar nodules are seen near the upper surface. The superficial nodules dip deeply into

the underlying liver substance. The rest of the liver is fatty. All that can be made out in the region of the gall-bladder is a thick fibrous scar. The spleen and pancreas are normal. The kidneys show moderate parenchymatous degeneration. The ureters, bladder, and genital organs are normal. The retroperitoneal glands are enlarged, but soft. The stomach is markedly dilated. The sigmoid flexure and rectum present small diverticula (about one-half inch in diameter) in communication with the intestinal lumen and following all along the line of the appendices epiploicæ. Vermiform appendix very large but normal.

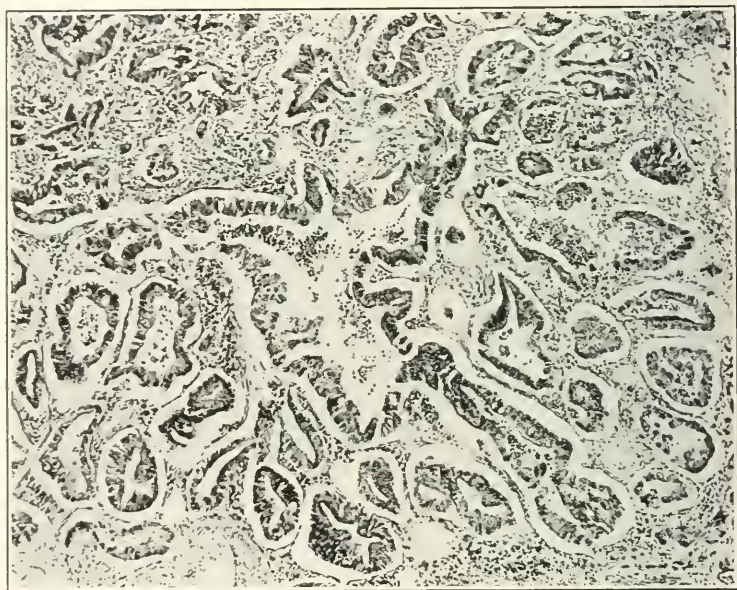


FIG. 1.—General alveolar appearance of the main tumor mass.

Anatomical Diagnosis: Primary carcinoma of the right lung, with secondary deposits in the left lung, bronchial glands, diaphragm, and liver.

The microscopic picture of the lungs is not uniform, but varies according as different parts of the lung or tumor are examined. Sections through the main mass of the newgrowth show alveolar structure (Figs. 1 and 2).¹ The alveoli are irregular in form and size, disorderly arranged, and indefinitely surrounded by a basement membrane. They are separated from one another by varying amounts of fibrous stroma with more or less round-cell infiltration. The lining cells are arranged in one and more layers, are not uniform in

¹ I wish to thank Dr. Leopold Jaches, of Cornell University, for his care in producing the photomicrographs.

size or shape, but more or less polygonal, and contain little granular protoplasm. The nuclei are large, and some of the cells contain more than one nucleus. Nucleoli are also seen. Very few of the alveoli contain mucus. Most of the lymph spaces and smaller bloodvessels are filled with these cells.

As the hilum pulmonis is approached the smaller bronchi, still containing cartilage, are found to be thickened, and in some places their mucous membrane is absent. The tumor process completely surrounds the bronchi, but here the newgrowth consists of large

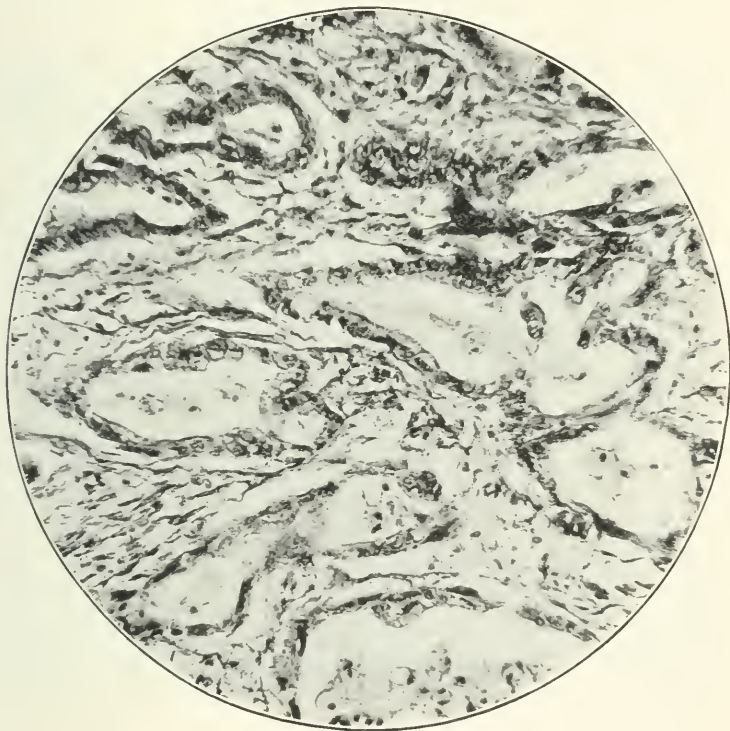


FIG. 2.—Same as Fig. 1, but high power, showing the polygonal character of the cells.

strands or clusters of cells without a basement membrane and without any alveolar arrangement. Separating these islands of cells are bands of dense fibrous connective tissue. The cells are very large and irregular in shape, some polygonal, others round. The nuclei stain very deeply, are usually multiple, occupy almost the entire cell, and are in an active state of mitosis. Some of the lymph spaces are filled with these cells. These strands stretch forth and diffusely invade the surrounding lung substance. The malignant nature of this tissue is quite evident.

Within the bronchial walls are found the normal bronchial mucous glands, and scattered amidst these are nests of alveoli similar in appearance to those described within the main mass of the tumor. The mucous glands and these alveoli of neoplastic origin are strikingly different in their appearance, but in some sections an indisputable relationship can be traced in their histological structure. For example, close to a bronchial mucous gland there will be a larger alveolus also containing mucus, in part lined by a single layer of columnar mucus-secreting cells upon a basement membrane, but in the remaining part of the alveolus the mucous cells have disappeared and in their stead are found irregularly polygonal cells with larger



FIG. 3.—High power of bronchial wall. Within it is an alveolus lined in part by cells of a glandular-secreting character and in part by polygonal cells similar to those forming the tumor mass.

nuclei, heaping into several layers, and breaking through the basement membrane (Fig. 3). It is these polygonal cells which have been described above as constituting the main mass of the tumor. Such places of histological metamorphosis are not very numerous, but distinct and certain.

In the strip of lung tissue immediately adjoining the tumor and apparently normal in the gross, microscopically numerous air vesicles are found invaded by cancerous proliferation of the alveolar type. Here, however, we see a distinct basement membrane and a

single layer of columnar non-ciliated cells. Their protoplasm is homogeneous, somewhat translucent, and stains very faintly with hematoxylin. The nucleus is single, small, and situated toward the base. Most of the alveoli contain mucus. Bronchi are absent. This general structure is entirely different from any thus far described, and vividly suggests glands secreting mucus (Fig. 4).

The lung tissue not involved by neoplasm shows reactions of several kinds. The walls of the respiratory alveoli are almost all thickened. Many of these alveoli are in a state of consolidation

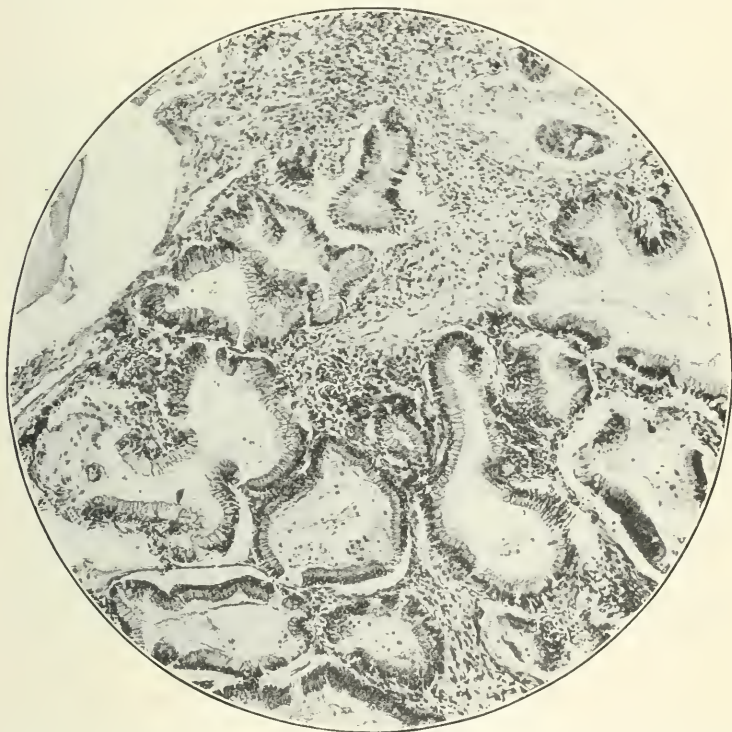


FIG. 4.—Section from macroscopically apparently normal lung tissue just outside of tumor mass. Shows alveoli of a distinctly glandular mucus-secreting type.

resembling pneumonia, the air vesicles being filled with fibrin, white blood cells, and desquamated epithelium. But the great majority show a catarrhal or desquamative inflammation, as they contain numerous swollen and degenerated epithelial lining cells. There are also areas of necrosis and areas with newgrowth of fibrous connective tissue infiltrated by leukocytes. Blood pigment is irregularly distributed within the tumor.

The metastatic nodules found throughout both lungs consist in part of the mucus-secreting glands, and in part of the alveoli lined

by polygonal cells. The nodules in the liver consist microscopically of strands of large, irregularly shaped, actively dividing cells with mitotic nuclei, and in some places attempting an alveolar arrangement but without regard whatever for the liver lobules (Fig. 5). The rest of the liver shows fatty degeneration and leukocytic infiltration. The type of tumor here is similar to that described above as surrounding the bronchioles. The bronchial glands, diaphragm, and subcutaneous tumor removed by operation show similar structure.

There seems to be no reasonable doubt that this is a primary cancer of the lung. The clearly metastatic nature of the nodules in the liver, diaphragm, bronchial glands, and left lung, and the absence

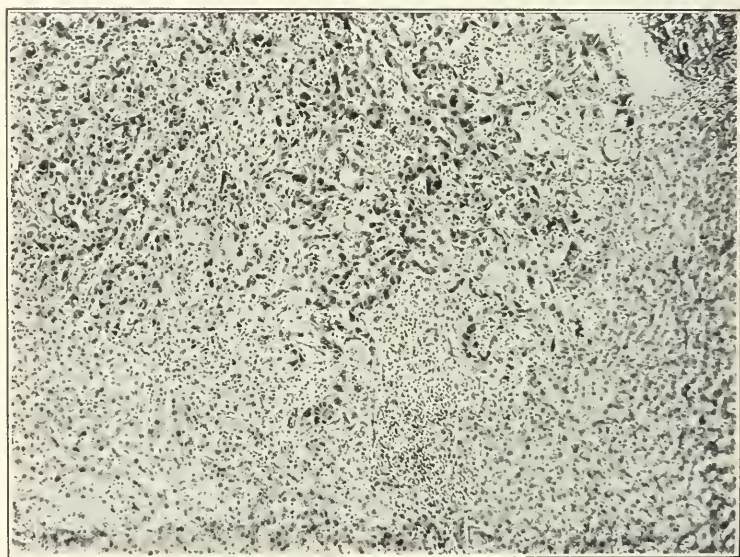


FIG. 5.—Liver with part of a metastatic nodule.

of tumor in every other organ of the body, furnishes convincing proof that the large tumor in the right lung is the primary seat of the cancer.

As to the starting point of primary cancer of the lung, we come to a subject of much discussion. Until comparatively recent times there was a tendency to fix upon the epithelium of the pulmonary alveoli as the point of origin of every lung tumor that was built up of polygonal or flat epithelium. At present it may be accepted as a fact that under varying conditions, mechanical and others, epithelium is very apt to change, and that the mere form of epithelium in the older and mature portions of the tumor can tell us nothing certain about its histological origin.

While the histogenesis of many cancers of the lung remains obscure,

it seems well assured that the great majority of this type of neoplasm is of bronchial origin, though carcinoma originating from the alveolar epithelium undoubtedly does occur. Those tumors that are of bronchial origin may start from the surface epithelium or they may take their origin from the bronchial mucous glands.

The tumor here described is of the latter class. For proof of this statement we must turn to those portions of the tumor which are the youngest and most recent in their development. These are clearly in our case those neoplastic foci scattered throughout the apparently normal lung in the gross, immediately adjoining the main tumor. The structure here is distinctly of a glandular mucus-secreting nature (Fig. 4). There is no part in the lung which this structure resembles more closely, or from which such a type of tissue can originate more readily, than from the bronchial mucous glands. Furthermore, the picture presented within the walls of the smaller bronchi still containing cartilage requires no hypothetical conclusions. Here we see distinctly the gradual development, from the epithelium of the bronchial mucous glands, of a new type of alveolus, lined by irregular polygonal cells. And it is this new type of alveolus which penetrates into the lung, fills the lymphatic spaces, invades the bloodvessels, and thus forms a great part of the newgrowth.

There are, no doubt, many portions of the neoplasm where, from mere examination of these parts only, one could not arrive at any definite results as to the origin of the tumor. Such places as the diffuse invasion surrounding the bronchial walls, the involvement of the diaphragm, and the metastases in the liver, belong to a stage of the tumor where it has lost its glandular mucus-secreting function and taken on, instead, the functions of growth and proliferation, and, therefore, appear differently. But here, too, one can trace a gradual transition between the earlier and later stages of this malignant growth.

From this summary, and the additional facts that the pulmonary alveoli and bronchial mucous membrane show no neoplastic tendency, there is conclusive evidence that this primary carcinoma of the lungs, originates from the mucous glands of the smaller bronchi still containing cartilage.

In completing this paper, there are several clinical features which presented themselves and which deserve a word of mention. As for the family history, our patient gave a distinct hereditary predisposition to tuberculosis. Several old tubercular lesions were found in the left apex. This co-existence of tuberculosis and carcinoma of the lungs, although denied in general by Rokitansky, is not at all rare. Wolff² has described 31 cases of carcinoma of the lungs, of which 23 were complicated by tuberculosis. Schwalbe³ has described 10 cases, of which 3 were complicated by active tuberculosis. Further-

² Fortschr. der Med., 1895, Band xiii, No. 13.

³ Deut. med. Woch., 1896, xii.

more Friedländer,⁴ Hildebrand,⁵ Seigert,⁶ and Ribbert⁷ described cases of carcinoma developing in tuberculous portions of the lung. These are only some of the references for the simultaneous occurrence of these two conditions.

In regard to the clinical diagnosis of tumor of the lung, this was made rather late in the disease. The probability of tuberculosis seemed so great that one was inclined at first to favor this diagnosis rather than carcinoma. The asymmetry of the chest, the diminished expansibility of the affected side, the bloody pleural fluid, and the persistence of dulness after evacuation of the fluid, can speak for both tuberculosis and carcinoma. The fact, however, that the apices remained practically clear while the process was localized entirely at the right base, and in addition to this the absence of tubercle bacilli, should have suggested strongly the diagnosis of carcinoma.

The sputum examination, too, proved interesting. It was examined almost daily, and the only almost constant finding was blood. Naturally it was profuse and mucopurulent. The variously described so-called characteristic "granule cells" ("Kernzellen") for carcinoma of the lungs were not found. As a rule, in a man over fifty, profuse expectoration which almost constantly contains blood and no tubercle bacilli, associated with physical signs denoting some abnormal lung condition, should always make one very suspicious of neoplasm.

The two complications which arose—the abscess of the lung and the empyema of gall-bladder—masked the diagnosis in the lungs to a great extent; but the fact that even after those operations the patient did not get any relief, but grew progressively worse, spoke highly in favor of an underlying malignant condition. When stenosis of the air passages became sufficient to produce symptoms, the diagnosis became more evident; but this, as usual, came late in the disease.

Summing up the age of the patient, the bloody pleural fluid, the persistence of dulness after tapping, and the constant presence of blood in the sputum without tubercle bacilli, one had enough ground for making the diagnosis of carcinoma of the lung.

I desire to express my thanks to Dr. I. Adler, through whose kind permission and help this case-report is published.

⁴ Fortschr. der Med., 1885, No. 10, p. 307.

⁵ Ziegler's Beiträge, 1888, Band ii.

⁶ Virchow's Archiv, 1893, Band cxxxiv, p. 287.

⁷ Deut. med. Woch., 1896, No. 11, p. 165.

THE DETECTION OF β -OXYBUTYRIC ACID IN THE URINE.

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IN a considerable number of diseases, notably in diabetes mellitus, the detection of β -oxybutyric acid is of great interest and of importance both from a diagnostic and therapeutic standpoint. The statement, repeated in a number of text-books on chemical diagnosis, to the effect "that when a urine, which has been fermented, deviates the plane of polarized light to the left, the presence of β -oxybutyric acid may be inferred," is certainly hesitating enough to leave some doubt in our minds as to this mode of detection. This doubt is augmented when we review the list of substances at times found in the urine which may produce the same effect. Among those most frequently encountered may be mentioned creatinin and various compounds of glyeonic acid. Also certain compounds of lead, which are formed when lead acetate is added in the process of clearing urine for examination in the spectroscope, have been shown by Magnus-Levy¹ to possess a marked levorotatory action.

It is not for lack of methods for the detection of β -oxybutyric acid that I venture to suggest a new one. Procedures have been worked out by a large number of investigators—Tollens,² Wolpes,³ Naunyn,⁴ Stadelman,⁵ Magnus-Levy,⁶ Bergell,⁷ Darmstädter,⁸ Waldvogel,⁹ Shaffer,¹⁰ and Black.¹¹ Some of these methods are adapted to the quantitative as well as the qualitative determinations of β -oxybutyric acid, some of them have serious defects, practically all are laborious chemical procedures which require many hours of work, the facilities of a well-equipped laboratory, and the manipulations of a skilled chemist. Parenthetically it may be said that the methods recently proposed by Shaffer and by Black have added much to our facility in determining oxybutyric acid and appear to be very accurate.

The method which is here presented is exceedingly simple, requires little time, needs no elaborate chemical apparatus, and can be applied by any general practitioner. It depends upon the following principles: The removal of acetone and diacetic acid by heat, the oxidation of β -oxybutyric acid to acetone by means of hydrogen

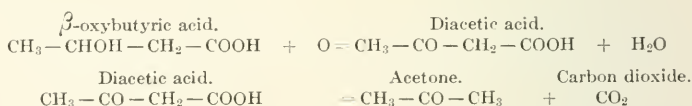
¹ Arch. f. exp. Path. u. Pharm., 1899, Band xlii.² Ann. d. chem., 1885, p. 228.³ Arch. f. exp. Path. u. Pharm., 1886, p. 21.⁴ Noth. Spec. Path. u. Ther., Band vii, 1, 181.⁵ Ueber den Einfluss der Alkalien auf d. menschl. Stoffe, Stuttgart, 1890.⁶ Arch. f. exp. Path. u. Pharm., 1901, Band xlv.⁸ Ibid., 1903, i, 37.⁷ Ztschr. f. physiol. Chem., 1901, Band xxxiii.⁹ Die Acetonkörper, Stuttgart, 1903, p. 38.¹⁰ Jour. Biol. Chem., 1908, v, 211.¹¹ Ibid., 1908, v, 207.

peroxide, and the detection of acetone in the urine thus treated by means of Lange's test.¹²

By boiling the preformed acetone, diacetic acid and the volatile fatty acids are removed from the urine; the boiling must be continued long enough completely to remove all of these bodies, and the urine after such treatment should give a negative result with Lange's test. This test depends upon the property of urine containing acetone to develop a purplish red color when treated with glacial acetic acid, a few drops of a watery solution of sodium nitroprussiate, and ammonia. The reaction is not given with alcohol or aldehyde; creatinin when present in considerable amounts gives a brownish color, which, however, may be distinguished from the purplish red color of the acetone reaction.

To the urine from which acetone, diacetic acid, and the volatile fatty acids have been removed, but which still retains its β -oxybutyric acid, peroxide of hydrogen is added. By this means the β -oxybutyric acid, as has been shown by Dakin,¹³ is oxidized to acetone. It may be noted that this cannot be a quantitative method, even in a rough degree, since Dakin has shown that the end-products of the oxidation of β -oxybutyric acid by peroxide of hydrogen consist of different substances varying in amount according to the course which the oxidation process takes, and is never acetone alone.

An abbreviated outline of the chemical process involved may be represented by these formulæ:



In the course of a study of the acetone bodies extending over a number of years I have never found β -oxybutyric acid in the urine unless a strong Arnold's¹⁴ reaction and a strong ferric chloride reaction (Gerhardt's) were present. To a urine showing these reactions the test for β -oxybutyric acid may be applied in the following manner:

To 20 c.c. of the suspected urine add 20 c.c. of water and a few drops of acetic acid and boil until the volume is reduced to about 10 c.c. To this residue add water to the original volume (*i. e.*, until it measures 20 c.c.). Put this into two test-tubes (B and C) of equal size, 10 c.c. in each test-tube. To one of the test-tubes (C) add one cubic centimeter of peroxide of hydrogen, warm gently for about one minute (do not boil), and then allow the fluid to cool. Add to each test-tube (B and C) one-half of one cubic centimeter of glacial acetic acid and a few drops of a freshly prepared watery solution of sodium nitroprussiate and mix. Overlay the solution in each test-

¹² Münch. med. Woch., 1906, Band liii, p. 1764.

¹³ Jour. Biol. Chem., 1908, iv, 77.

¹⁴ Archives of Internal Medicine, February, 1908.

tube with 2 c.c. of concentrated ammonium hydroxide. Allow these to stand for four or five hours, and at the end of this time compare the two test-tubes. At the point of contact between the ammonia and the underlying fluid B will show no ring (or a faint brown ring if much creatinin is present), test-tube C, to which hydrogen peroxide was added, will show a purplish red contact ring if β -oxybutyric acid was originally present; if β -oxybutyric acid was not present, the two test-tubes will not differ in appearance. If the two test-tubes are now shaken, the difference in color will be seen throughout the fluid; this difference is intensified by allowing the tubes to stand for fifteen or twenty minutes after shaking.

To detect slight differences in the color of the rings, the two test-tubes should be held side by side against a white background while the observer stands with his back to the light.

The oxidation by means of hydrogen peroxide is gradual and reaches its maximum in about four or five hours, after which the color slowly fades. When a very large amount of β -oxybutyric acid is present the difference in the two test-tubes may become evident in a few minutes. It is always well to prepare the two test tubes as above for comparison. B will show whether all preformed acetone and diacetic acid have been driven off, and will also show the creatinin ring (if present), so that its color may be compared with the color of the ring in tube C.

The test may be applied to the urine either before or after fermentation; the presence of sugar does not interfere with the reaction. If albumin is present it should be removed by filtration after the urine has been boiled.

The method is moderately delicate and will certainly detect β -oxybutyric acid when present to the extent of 0.3 per cent. and probably less.

The following table shows a number of urines in which the test, as above described, showed a positive reaction for β -oxybutyric acid in which the acid was quantitatively determined by Shaffer's method.

Specimen number.	Levorotation after fermentation.	Quantity in 24 hours, c.c.	β -oxybutyric acid.		
			Total grams.	Grams per liter.	Per cent.
1	0.7	4050	26.60	6.6	0.66
2	0.7	2310	11.94	5.2	0.52
3	0.5	1800	10.82	5.1	0.51
4	0.6	1800	9.15	5.0	0.50
5	0.5	4650	21.67	4.7	0.47
6	0.5	2550	8.01	3.1	0.31
7	0.2	3360	8.68	2.6	0.26

That the test is somewhat delicate may be inferred from the fact that I have obtained it in a number of diabetic urines with a levorotation after fermentation of 0.2 and a ferric chloride reaction much weaker than that given by any of the above urines in which the oxybutyric acid was quantitatively determined. It has been my experience that the amount of β -oxybutyric acid varies directly (although not necessarily proportionately) with the amount of diacetic acid present and that the ferric chloride reaction varies directly in intensity with the amount of diacetic acid present.¹⁵

In a number of normal urines tested the reaction has not been obtained. It was also absent in a number of urines showing a weak ferric chloride reaction.

THE EFFECT OF CERTAIN SO-CALLED MILK MODIFIERS ON THE GASTRIC DIGESTION OF INFANTS.

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IN the fall of 1907, at the instigation of Dr. L. Emmett Holt, investigations were undertaken at the Rockefeller Institute in New York, in the hope of throwing light on some of the as yet obscure questions of infant digestion. The problem to be attacked was that of the digestion of milk in the infant's stomach, and more particularly the exact action of the more commonly used, so-called "milk modifiers," and their influence upon digestion both in health and disease.

A review of the literature of the gastric digestion of the infant¹ shows much valuable work on its physiology and its variations according to age and health. It has been shown that all the physiological factors occurring in the adult stomach are present in the infant, but in weaker form. It has further been proved that the younger the infant, the more active the motility of the stomach, that this motility is greater with woman's milk than with artificial food, and in health than in disease. It has been proved that the acidity of the gastric contents increases regularly after a meal for some time, but that free hydrochloric acid cannot be demonstrated for an hour or more after the ingestion of the food. This phenomenon has been shown to be due not to a lack of secretion of hydrochloric acid during the early stages of digestion, but to the striking power which

¹⁵ Archives of Internal Medicine, February, 1908.

¹ AMER. JOUR. MED. SCI., 1909, cxxxvii, 674.

casein has to combine with or adsorb it. Heubner has found that to 100 c.c. of cow's milk could be added 0.324 gram of hydrochloric acid before any test for the free acid could be obtained. Woman's milk will take up about one-half of that amount. It has further been proved that it is that hydrochloric acid which is combined with the protein which acts in peptic digestion, and that only, while the occurrence of free hydrochloric acid is merely a sign that more of the acid is present than is required for complete digestion of the protein. Opinions differ as to the occurrence of lactic and volatile fatty acids in the child's stomach, while the presence of a fat-splitting enzyme has been both asserted and denied. Pepsin is always found in the infant stomach in both health and disease, and gastric digestion goes on to the formation of small amounts of peptones but no amino-acids. Rennin is always present after the first few weeks of life. Whether before that, or not, is a moot question.

For many years the medical profession has been adding barley water and lime water to cows' milk to increase its digestibility, and in more recent years sodium citrate and malt extract have been used extensively. There are many physicians who believe that each of these substances is at times of value in infant feeding, and each probably has his own rules by which he determines which is indicated in a particular case. Such knowledge, however, is largely empirical, as we have but little idea, or, at least, proof of what these substances do in the stomach and what the chemistry of their action really is. With the exception of some work of Einhorn twenty years ago, in which he investigated the motility and acidity of the gastric contents after feeding woman's milk, cow's milk and water, cow's milk and barley water, and several artificial foods, practically nothing has been done along these lines.

In these investigations, it was considered advisable first to use normal infants. This, however, not being practical, owing to the difficulty of obtaining such in a hospital, children who approached as nearly as possible a normal state of health were selected. All were patients at the Babies' Hospital in New York, and none were suffering from obvious digestion disturbances at the time of the examination. To obviate, as far as possible, the error due to individual variations it was attempted to take each case through a complete series of comparative examinations. In all 122 observations were made on 24 such infants, varying from two to eight months of age.

The test feedings given were of three series, designated Series I, II, and III. The purpose of Series I was to investigate the effect of the substances employed upon gastric secretion and for this purpose they were given with water alone. The three test feedings of this series consisted of a 5 per cent. solution of milk sugar—as an inert substance—barley water, and a 5 per cent. solution of lime water. In Series II, the substance was added to a mixture of cow's milk and water, equal parts. In this series was included

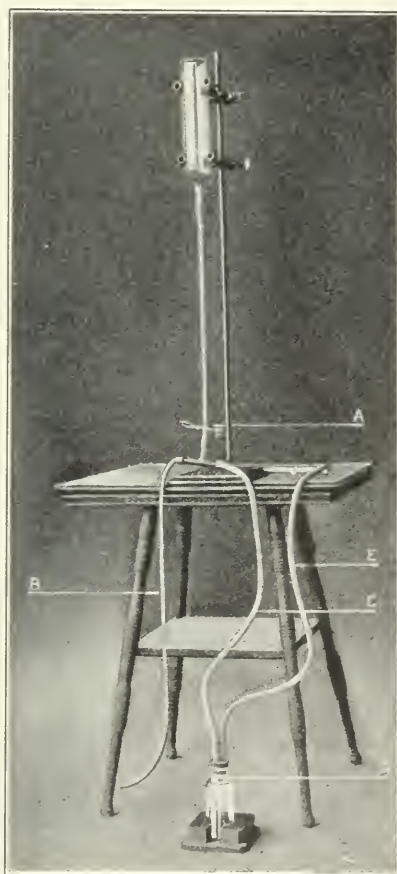
woman's milk undiluted. It therefore embraced woman's milk, cow's milk and water, cow's milk and barley water, equal parts, cow's milk and water with 5 per cent. lime water, and cow's milk and water with 1 grain of sodium citrate to the ounce. In Series III, experiments were made with cow's milk in the dilution of one part in four, and lime water, barley water and sodium citrate were investigated. In nearly all the cases, the test feeding was given the first thing in the morning, six to eight hours after the preceding nourishment. In a few only was the stomach washed a half-hour before the feeding. Owing to the various times which the child took in ingesting the meal, it was deemed more reliable to take the time from the minute at which the feeding was finished rather than from that of its beginning. This was done in every case.

On account of the difficulty sometimes encountered in removing the stomach contents of young infants by the ordinary method of stomach tube and funnel, and the necessity of working as rapidly as possible, a special apparatus was constructed for this purpose (see illustration). This consists of a graduated glass reservoir holding 500 c.c. of water, attached by a clamp to an iron upright so that it stands about two feet above the table. From the outlet, two to three feet of soft rubber tubing leads to a T-tube of large caliber. Just above the T-tube is a pinch cock (*a*). Over one arm of the T-tube is drawn the stomach tube, a soft rectal tube either 22 or 23 French (*b*). From the second arm of the T-tube runs a stiff tubing (*c*) to a bottle on the floor (*d*). The bottle fits into a wooden stand to keep it in an upright position and is supplied with a tightly fitting rubber stopper, through which protrude two glass tubes. The tubing (*c*) from the T-tube fits tightly over one, while from the second extends about four feet of similar stiff tubing (*e*). This last is held in the mouth of the operator and is used to apply gentle suction when for any reason the stomach contents do not siphon quickly. The bottle is detachable and is used as a specimen bottle.

In the investigation under consideration, the contents were removed without washing. The rubber stopper was then transferred to a second specimen bottle and, when desired, the stomach washed by alternately opening and closing the pinch cock at the same time with the fingers pinching and opening the tube (*c*) from the T-tube to the specimen bottles. This wash water was not used for investigation, and the lavage was performed merely to make it certain that most of the stomach contents had been obtained, or for therapeutic purposes. It was surprising to see how large a stomach tube a young infant could be made to swallow if held in an upright position in the nurse's arms, if no attempt was made to pass the pharynx until the child took a deep inspiration. The tube was passed with great ease and apparently with a minimum of discomfort. Most of the children, after having overcome the initial fright, and having become slightly used to the procedure, made very little effort to cry

and some seemed quite content to suck on the tube. Though some of the babies failed to gain weight during the period of investigation—possibly due to the frequent changes in the foods used—no serious or injurious results followed the procedure.

The specimens were taken at once to the chemical laboratories of the Rockefeller Institute and under the supervision of Dr. P. A.



Apparatus used to evacuate the stomach. (For description see the text.)

Levene, submitted to the following examinations: The quantity was carefully measured in order that by this means a rough estimate of the gastric motility might be obtained (A)². The inaccuracy of drawing exact conclusions owing to the varying consistency of the milk curd and the uncertainty of complete evacuation is thoroughly appreciated. The acidity was estimated by titration with $\frac{n}{10}$ NaOH,

² Letters in parentheses refer to the columns in the tables in which the results are recorded.

phenol-phthalein as an indicator (B). The hydrochloric acid in a free state was tested qualitatively with Congo red paper and quantitatively by titration against dimethylamidoazobenzol. The specimen used for the estimation of acidity, usually 5 c.c., after being neutralized was transferred to a platinum dish and evaporated over the steam bath to dryness. It was then carefully carbonized over a free flame, and the residue washed into a porcelain dish. In this, the chlorides were estimated by the method of Volhard. This result was calculated as parts per mille and recorded as "total chlorides" (C). A second portion of the contents was evaporated without the addition of NaOH, carbonized, and the chlorides estimated by the same method. This constituted the inorganic or fixed chlorides (D). The difference between the total chlorides and the sum of the fixed chlorides and free hydrochloric acid, shows the amount of chlorides which have gone into chemical combination with the milk proteins and are recorded as "organically bound chlorides" (E). It is this last item which is of importance in estimating the digestive capacity of various stomach contents when proteins are in the stomach. It has been shown by various authors that it is the combined chlorides only which act in peptic digestion, and that free hydrochloric acid in the stomach is merely a sign that more acid has been secreted than is required for complete digestion. The inorganic or fixed chlorides are, of course, inert. Acidity, fixed chlorides, and total chlorides will vary markedly with the food taken into the stomach, whereas the combined chlorides designate the exact amount which is being put to practical use. Tests were made in a number of cases for lactic acid, but as it was found in no case examined the proceeding was discontinued.

The method of estimating the digestive power of the gastric contents varied according to whether there were protein substances in the test meal or not. In Series I in which the "modifier" was given in water, without milk, the method was as follows: To each of the three portions of 5 c.c. of the contents was added 2 c.c. of fresh cow's milk. Portion A was untreated. To portion B was added $\frac{1}{10}$ N HCl until the casein had become saturated with the acid, as shown by the test for free acid with Congo red paper. Portion C was boiled before the milk was added, and then acidified in the same way as D. To each portion was added 1 c.c. of toluol. For A and B 25 c.c. measuring flasks were used; C requiring boiling, was placed in a small Erlenmeyer flask. All these portions were then placed in the incubator at body temperature for twenty-four hours. At the end of this time C was washed into a 25 c.c. measuring flask, by means of a saturated solution of zinc sulphate in five per cent. H_2SO_4 . Enough solid zinc sulphate was added to each flask to saturate the solution, and the contents then raised in volume to 25 c.c. by adding the saturated zinc sulphate solution. The flasks were then placed in the ice box for twenty-four hours more.

This latter proceeding was to insure a constant temperature at which the coagulation took place regardless of the season. At the end of the twenty-four hours the specimens were filtered through folded filter papers. The amount of N in 10 c.c. of the filtrate was determined by the Kjeldahl process. The amount of nitrogen calculated for the 25 c.c. is designated as "peptone nitrogen." The amount of N in the filtrate of portion C (I) that portion which was boiled previous to the addition of the milk shows the amount of peptone and residual N in the given amount of contents and milk, and is used as a control, the amount being subtracted from the amount of N in the filtrates of A and B.

The amount of N, therefore, in the filtrate of A after the deduction of C gives the absolute amount of N in the form of peptones which were produced by the action of 5 c.c. of the stomach contents upon 2 c.c. of milk in twenty-four hours (J), whereas the N in the filtrate of B, similarly corrected by the deduction of C, gives the amount of peptone formation in twenty-four hours when the amount of acid is practically the same in all cases—in other words, an estimate of the amount, or at least activity, of the pepsin itself (K).

In Series II and III in which milk was given in the test meal the procedure was somewhat different. The contents were thoroughly mixed and then three equal parts measured out: when possible 15 c.c. in each part, when lack of material prevented, 10 c.c. One portion A was saturated at once with ZnSO_4 and the volume raised to 25 c.c. by the saturated ZnSO_4 solution. The second portion B was placed in the incubator with toluol for twenty-four hours and then saturated with ZnSO_4 , while the third portion C was acidified with $\frac{n}{10}$ HCl until the free acid showed a reaction to Congo paper, and then treated in the same manner as B. All three portions on being saturated with ZnSO_4 were placed in the ice box for twenty-four hours and then treated in a similar manner to the specimen in Series I. The amount of N in the filtrate of portion A represents the peptones and residual N in the stomach at the end of an hour (G). This is, however, but a very rough estimate of the gastric digestion which has taken place, as it is open to variations due to the amount of peptone in the food and to the much greater variation dependent upon absorption and motility. The difference, however, between the amount of peptone at the end of the hour and that of the twenty-four hours more in the thermostat, while not designating the digestion which has taken place, in the stomach may be used as an indication of the digestive power of the gastric juice at the time of its removal and is designated as "increase in peptone nitrogen" (J). The difference between the peptone N of C and A by eliminating variations in acidity similarly estimates the activity of the pepsin in the stomach at the end of the hour (K).

Lastly to each of three small test tubes was added 1 c.c. of gastric contents, in Series I unfiltered, in Series II and III filtered. Tube

I was untreated (L); II was acidified with HCl until it showed bright red with dimethylamidoazobenzol (M); and III was boiled and acidified (N). The digestive power of these were then tested by the method of Mette, the digestion being estimated after twenty-four hours at body temperature.

These results were of use not only to confirm the previous findings but to show the presence or absence of "free pepsin," that is, pepsin not combined with the protein. The absence in every case of albumen digestion in the specimen which had been boiled and acidified (N) precluded the action of the acid in causing the digestion while the addition of toluol precluded bacteria.

Specimens of the test feedings as given to the patient were also examined for peptone N (Q), and total chlorides (P).

RESULTS. The results of these investigations are incorporated in tables of averages.

TABLE I.—*Normal infants. Investigation of lactose, lime water, and barley water administered in water, without milk. The specimen was removed from the stomach thirty minutes after the end of the feeding.*

	Number of cases	Amount of material removed from stomach			Total acidity	Total chlorides	Fixed chlorides	Free hydrochloric acid	Peptone nitrogen after 24 hours in the thermostat; untreated contents	Peptone nitrogen after 24 hours in the thermostat; acidified contents	Peptone nitrogen after 24 hours in the thermostat; boiled contents	Increase of peptone nitrogen; untreated contents	Increase of peptone nitrogen; acidified contents	Mette's tube tests; untreated contents	Mette's tube tests; acidified contents	Mette's tube tests; boiled contents
		c.c. A	$\frac{0}{100}$ B	$\frac{0}{100}$ C												
5% lactose solution	11	37	0.23	0.40	0.24	0.16	2.3	4.3	1.5	0.8	3.8	0.32	2.79	0		
Lime water, 5 parts water, 95 parts	15	36	0.31	0.61	0.41	0.20	3.1	4.6	1.2	1.9	3.4	1.07	3.46	0		
Barley water	12	50	0.34	0.82	0.69	0.13	2.6	5.4	1.3	1.3	4.1	0.35	3.00	0		

Healthy Infants. Examining first Series I (Table I), in which the substance to be investigated was given with water only, the following facts will be noted: Using the sugar and water as a control, it is seen (A) that the amount of material obtained was smallest after sugar and water and lime-water, and larger after barley water. The total acidity (B) is higher after both lime water and barley water than after a plain milk sugar solution; the total chlorides (C) are higher after lime water than after sugar and highest of all after barley water; while the fixed or inorganic chlorides (D) vary in about the same ratio, leaving, however, most free HCl (F)

after lime water and least after barley water. From these results, it would appear that any increase in chlorides following the administration of barley water is due to the extra salt given in the food, while when the lime water is used, an absolute increase of hydrochloric acid secretion results.

Examining now the digestive power of the gastric juice, it will be seen (J) that 5 c.c. of the stomach contents was able to produce in twenty-four hours from 2 c.c. of cow's milk very little peptone after sugar, more after barley water, and most after lime water, while the next column, that in which the acidity was equalized to demonstrate the relative amount of pepsin (K), the variations are much less in proportion, but show, if anything, the greatest amount of pepsin after barley water. The Mette's tube experiment, when unacidified (L), confirms the relative digestive powers of the different contents (J), while the next column (M), the Mette's tube acidified, tends to show again that the amount of pepsin varies but slightly.

In Series II (Table II), that in which woman's milk undiluted and equal parts of milk and water were given in the test feeding, the amount obtained (A) after feeding woman's milk is distinctly higher than after the other feedings, which here include sodium citrate, one grain to the ounce. The total acidity (B) is practically the same in all cases though somewhat higher after each of the three "modifiers" than after the plain milk. The total chlorides (C) are again higher after barley water and lime water, but slightly lower after sodium citrate than after the plain milk. A marked variation appears in the fixed chlorides (D). Taking the milk and water as a standard, the fixed chlorides, after a feeding including lime water, barley water, and sodium citrate are distinctly raised. The increase after barley water is again explainable by the larger amount in the food (P), the other three feedings showing practically the same salt contents. The low total chlorides and fixed chlorides after woman's milk are also explicable from the smaller amount found in the food. There being in no case free HCl (F) found in these rich milk diets, the difference between the total and fixed chlorides was the active organically bound chlorides (E). This shows that, though after lime water a certain amount of the hydrochloric acid was converted into calcium chloride and rendered inert, nevertheless a sufficient excess of the acid was secreted to raise that organically combined with the casein to the normal and to fulfill the demands of digestion. After barley water, though the excess of chlorides was due in a large part to that given in the food, a slight increase of combined chlorides is shown. After sodium citrate, the sodium bound the greater part of the HCl, while no stimulation to a further increase was offered, thus leaving a minimum of acid to act in digestion.

A study of the amount of peptone N found in the stomach at the end of the hour (G) shows, with the exception of woman's milk, whose high content is due to the large amount of residual nitrogen in the food (Q), approximately similar results, with the lime water slightly the highest, and sodium citrate a shade low. The increase of peptone N during twenty-four hours in the incubator (J) shows that the digestive power following milk and water, lime water, barley water, and sodium citrate is about equal. The increase of peptone N after acidification with HCl and twenty-four hours in the thermostat (K) shows practically similar amounts of pepsin following cow's milk and water and cow's milk and barley water, whereas after sodium citrate and lime water it is a trace lower. This low figure after lime water is difficult to explain as it is at variance with all the other results. The amount of free pepsin, as shown by the Mette's tubes, is practically the same in all except woman's milk and barley water, which are low.

TABLE III.—*Normal cases. Investigation of lactose, barley water, and sodium citrate, administered in cow's milk, 1 part, water, 3 parts. Time in the stomach, sixty minutes after the end of the feeding.*

	Number of cases	Amount of material re- moved from stomach	Total acidity	Total chlorides	Fixed chlorides	Organically bound chlo- rides	Free hydrochloric acid	Mette's tube tests; un- treated contents	Mette's tube tests; acidified contents	Mette's tube tests; boiled contents
		c.c. A	$\frac{0}{(10)}$ B	$\frac{0}{(10)}$ C	$\frac{0}{(10)}$ D	$\frac{0}{(10)}$ E	$\frac{0}{(10)}$ F	mm. L	mm. M	mm. N
Cow's milk, 25% in water	7	36	0.75	1.33	0.64	0.65	0.04	0	2.66	0
Cow's milk, 25% in water, 5% lime water	7	30	0.97	1.27	0.60	0.64	0.03	0	2.50	0
Cow's milk, 25% in barley water	8	23	1.13	1.67	0.84	0.70	0.13	0	2.86	0
Cow's milk, 25% in water, sodium citrate, 0.2%	5	21	0.71	1.09	0.92	0.18	0.00	0	2.55	0

The third series of experiments as shown in Table III, that in which the substances under investigation were given with one part of milk in four, tend partially to confirm the findings of Series I and II. Lime water and barley water increase the total acidity (B), while the amount of free HCl (F) is too minute for consideration, though it should be noted that sodium citrate is the only substance used in this series, after which no free HCl was demonstrated in the gastric contents. The total chlorides (C) are highest after barley water and lowest after sodium citrate, while the fixed chlorides are highest after sodium citrate, leaving again an equality of combined chlorides (E) after milk and water and lime water and barley, with

a great decrease after sodium citrate. The figures demonstrating peptic digestion in this series are not very trustworthy, as the small amount of stomach contents usually obtained precluded thorough investigation of this point, and they are therefore omitted.

It would be inadvisable to attempt to draw definite conclusions from these series of experiments owing to the well known fallacies of averages in physiological work. A few facts, however, seem to be sufficiently suggestive to warrant their mention. It would appear, from the fact that in every case the addition of acid to the contents caused a greater increase of peptone formation than in the specimens in which the acid was not used, that when a deficiency of protein digestive power exists, it is due to a lack of acid rather than any want of pepsin. There is always more than enough pepsin in proportion to the amount of acid. As to the effects of the various substances investigated, it would appear that barley water has but slight, if any, effect upon HCl secretions. Lime water although usually given with the idea of reducing the acidity of the stomach may have quite the opposite result. Though a portion of the HCl found in the stomach is neutralized by the lime, the alkali stimulates to an increased secretion of HCl which may raise the acidity even higher than that obtained with milk alone. Sodium citrate, on the other hand, would appear to act in quite the opposite manner for, though preventing coarse curds, it converts most of the HCl into sodium chloride, liberating citric acid—a substance considered of little value in digestion—and does not stimulate further secretion of HCl. It would thus appear to weaken the protein digestive power of the gastric juice by using up its hydrochloric acid.

PATHOLOGICAL CASES. Having learned these facts concerning the physiology of the infant stomach and the effect of lime water, barley water, and sodium citrate upon the gastric secretion in health, it seemed advisable to undertake investigations upon cases suffering from digestive and nutritional disorders, in order to learn to what extent their gastric secretion varied from the normal and if possible to ascertain whether these various substances acted upon the diseased stomach in the same manner as upon the healthy organ. For this purpose two classes of cases were examined—marasmus cases without vomiting, and persistent chronic vomiting cases. Of the first class 14 cases were studied and 35 examinations were made, while of the chronic vomiting cases, 10 infants were used and 30 meals extracted. In these cases the test feeding given consisted of lactose, barley water, or lime water, given in water only, in the same concentration as was used with the healthy infants.

TABLE IV.—*Marasmus cases. Investigation of lactose, lime water, and barley water, administered in water without milk. Time in the stomach, thirty minutes after the end of the feeding.*

	Number of cases	Amount of material removed from stomach	Total acidity	Total chlorides	Fixed chlorides	Free hydrochloric acid	"Peptone nitrogen" after 24 hours in the thermostat; untreated contents	"Peptone nitrogen" after 24 hours in the thermostat; acidified contents	"Peptone nitrogen" after 24 hours in the thermostat; boiled contents	Increase of peptone nitrogen; untreated contents	Increase of peptone nitrogen; acidified contents	Mette's tube tests; untreated contents	Mette's tube tests; acidified contents	Mette's tube tests; boiled contents
		c.c. A	$\frac{0}{100}$ B	$\frac{0}{100}$ C	$\frac{0}{100}$ D	$\frac{0}{100}$ F	mgr. G	mgr. H	mgr. I	mgr. J	mgr. K	mm. L	mm. M	mm. N
5% lactose solution	14	20	0.28	0.34	0.21	0.13	3.5	5.7	1.6	1.9	4.1	0.22	3.62	0
Lime water, 5 parts; water, 95 parts	9	25	0.33	0.50	0.32	0.21	3.2	4.4	1.9	1.6	2.5	1.16	3.22	0
Barley water	8	30	0.40	1.46	1.19	0.20	3.4	5.0	1.7	1.7	3.3	1.33	3.84	0

TABLE V. (Compiled from Tables I, IV, and VI).—*Table showing the differences between the gastric contents of the various classes of infants studied. The test feedings consisting of a 5% solution of lactose in water. The stomach contents were removed thirty minutes after the end of the feeding.*

	Number of cases	Amount of material removed from stomach	Total acidity	Total chlorides	Fixed chlorides	Free hydrochloric acid	"Peptone nitrogen" after 24 hours in the thermostat; untreated contents	"Peptone nitrogen" after 24 hours in the thermostat; acidified contents	"Peptone nitrogen" after 24 hours in the thermostat; boiled contents	Increase of peptone nitrogen; untreated contents	Increase of peptone nitrogen; acidified contents	Mette's tube tests; untreated contents	Mette's tube tests; acidified contents	Mette's tube tests; boiled contents
		c.c. A	$\frac{0}{100}$ B	$\frac{0}{100}$ C	$\frac{0}{100}$ D	$\frac{0}{100}$ F	mgr. G	mgr. H	mgr. I	mgr. J	mgr. K	mm. L	mm. M	mm. N
Normal cases . . .	11	37	0.23	0.40	0.24	0.16	2.3	4.3	1.5	0.8	3.8	0.32	2.79	0
Marasmus cases . . .	14	20	0.28	0.34	0.21	0.13	3.5	5.7	1.6	1.9	4.1	0.22	3.62	0
Hypoaecidity vomit- ing cases	4	40	0.15	0.19	0.09	0.08	2.3	3.9	1.7	0.6	2.2	0.08	3.50	0
Hyperaacidty vomit- ing cases	6	28	0.44	0.52	0.20	0.33	4.5	6.9	2.1	2.4	4.8	1.61	4.55	0

The marasmus cases (Table IV) show very slight variation from the normal infants (Table V). The amount of material obtained

(the stomach was here evacuated thirty minutes after the child had finished its feeding) was slightly less than in the normal, whereas the total acidity and free HCl were practically equal in the two series. The increase chloride secretion following the administration of lime water shows quite as well in these cases as in the healthy children. It is of interest to note that the peptic activity in these cases is not reduced, appearing to be even a little greater than in the normal infants.

TABLE VI.—*Chronic vomiting cases. Investigation of the gastric contents in the two classes of this condition, and the effect of lactose, lime water, and barley water upon them. Time in stomach, thirty minutes after the end of the feeding*

	Number of cases	Amount of material removed from stomach	Total acidity	Total chlorides	Fixed chlorides	Free hydrochloric acid	"Peptone nitrogen" after 24 hours in the thermostat; untreated contents	"Peptone nitrogen" after 24 hours in thermostat; acidified contents	"Peptone nitrogen" after 24 hours in the thermostat; boiled contents	Increase of peptone nitrogen; untreated contents	Increase of peptone nitrogen; acidified contents	Mette's tube tests; untreated contents	Mette's tube tests; acidified contents	Mette's tube tests; boiled contents
<i>Hypoauidity cases</i>	c.c.	$0'_{(10)}$	$0'_{(10)}$	$0'_{(10)}$	$0'_{(10)}$	$0'_{(10)}$	mgr. G	mgr. H	mgr. I	mgr. J	mgr. K	mm. L	mm. M	mm. N
5% lactose solution	4	40	0.15	0.19	0.09	0.08	2.3	3.9	1.7	0.6	2.2	0.08	3.50	0
5% lime water solution	3	34	0.06	0.40	0.37	0.01	1.6	3.8	1.2	0.4	2.6	0.00	3.20	0
Barley water	2	33	0.27	0.55	0.42	0.06	3.5	4.3	1.9	1.6	2.4	0.00	4.42	0
<i>Hyperacidity cases</i>														
5% lactose solution	6	28	0.41	0.52	0.20	0.33	4.5	6.9	2.1	2.4	4.8	1.61	4.55	0
5% lime water solution	6	23	0.39	0.60	0.30	0.31	3.2	4.4	1.7	1.5	2.7	1.05	3.52	0
Barley water	4	38	0.39	0.77	0.54	0.21	3.2	4.2	2.1	1.1	2.1	0.59	3.58	0

In the *chronic vomiting cases* (Table VI), of which ten were studied, it was early seen that they naturally fell into two classes. In four of them the acid contents was distinctly subnormal and in the other six it was exceptionally high. In the *hypoauidity vomiting cases* the total acidity (B) was very slight and free HCl (F) either absent or present only in minute traces. These cases responded slightly to the administration of lime water, as is shown by the higher total chloride content of the stomach, but not sufficiently to neutralize the lime, and the free HCl was present in a trace only in one case. The peptone-forming power of the untreated stomach contents was somewhat low, while the action on the Mette's tubes was practically nil (I.). That the failure of digestive power was due to a lack of acid,

and not to any deficiency of pepsin is shown by the strong action in the Mette's tubes after acidification of the specimens (M).

In the *hyperacidity vomiting cases* (Table VI) the total acidity (B) and free HCl (F) were distinctly high after all the test diets, the total chlorides and fixed chlorides varying in the same ratio as in the normal. The peptone formation from milk was also distinctly above normal (J) as was the Mette's tube estimations. The lack of an increase of digestive power of the acidified specimen, with the single exception of the milk sugar specimens, shows that this increase of proteolysis is again due to an increased acidity and not to any increase of pepsin.

Finally to learn whether these effects of the salts used in infant feeding occurred in all cases, a short series of experiments were made in which 18 unselected infants, the entire content of a ward, were examined for the acidity and chlorides (Table VII). In these cases the test feeding consisted of two parts of cow's milk and one part of water, and the substances used were lime water, 5 per cent., sodium citrate 0.2 per cent., and potassium carbonate 0.1 per cent., with sufficient lactose to make the carbohydrates 6 per cent. The meals were extracted one hour after the child received the bottle, in this respect differing from the other experiments. In this series the effect of lime water shown in the other experiments is not evident, but that of sodium citrate is fully confirmed by the increase of the fixed chlorides and consequent reduction in the organically combined chlorine. The potassium carbonate also increased the fixed chlorides and reduced the organic chlorine, but not so markedly as did the citrate. There was no increased stimulation of HCl by this salt.

TABLE VII.—*Unselected ill infants. Investigation of sodium citrate, lime water, and potassium carbonate administered in a mixture consisting of cow's milk, 1 part, water, 2 parts, and lactose sufficient to make 6%. (1.40–6–1.30.)*

	Number of cases	Amount of material removed from stomach	Total acidity	Total chlorides	Fixed chlorides	Organically bound chlorides	Free hydrochloric acid
		c.c. A	$\frac{0}{100}$ B	$\frac{0}{100}$ C	$\frac{0}{100}$ D	$\frac{0}{100}$ E	$\frac{0}{100}$ F
Cow's milk and water	18	46	0.85	0.98	0.29	0.69	0
Cow's milk and water; 5% lime water solution	17	51	0.78	0.94	0.24	0.68	0
Cow's milk and water; sodium citrate 0.2%	13	44	0.85	0.91	0.65	0.26	0
Cow's milk and water; potassium carbonate 0.1%	15	52	0.64	0.97	0.44	0.52	0

REVIEW OF RESULTS. While fully appreciating the danger of drawing definite conclusions from the results of physiological investigations when these results are based on averages of the findings, a review of the above tables would seem to suggest at least certain facts. The motility of the stomach appears to be in inverse proportion to the concentration of the milk in the solution. The greater the dilution the more rapidly the organ empties itself. Lime water itself appears not to act, as is generally accepted in practical pediatrics, by reducing the acidity of the child's stomach. While unquestionably neutralizing a portion of the hydrochloric acid, the alkali stimulates in a further secretion of gastric juice. This raises the amount available in the form of free acid or organically bound chlorine at least to the amount normally occurring when the lime water is not added, and may cause a distinct over-stimulation of the gastric glands sufficient to produce a slight relative hyperchlorhydria. The effect of barley water in the stomach appears, at least from the purely chemical viewpoint, to be very slight, neither stimulating nor retarding gastric secretion. The action of sodium citrate, however, is quite definite. It acts similarly to the alkalies in converting a large portion of the hydrochloric acid into sodium chloride, while at the same time it does not stimulate to a further secretion of acid. In this way it reduces decidedly the amount of hydrochloric acid in the stomach. How potent a factor this may be in the well known action of this salt in preventing the formation of curd in the infant stomach is an open question. It has been shown by several observers that in the young infant the amount of rennin is very slight and it is possible that most of the clotting is due rather to the action of the acid in the stomach than to the ferment.³

³ That sodium citrate does act in inhibiting acid clotting is shown by the following simple experiment: Into each of eight Erlenmeyer flasks was placed 5 c.c. of fresh cow's milk and varying amounts of *n*/10 sodium citrate solution. After sufficient distilled water had been added to make the volume of fluid the same in all the flasks the solutions were titrated with *n*/10 HCl until clotting occurred. From the accompanying table it will be seen that each increase in the sodium citrate in the milk required a proportional increase of the HCl to produce the clot.

Flask	Cow's milk c.c.	<i>n</i> /10 sodium citrate added to milk c.c.	Distilled water added c.c.	Amount of <i>n</i> /10 HCl required for clotting c.c.	Increase in the quan- tity of HCl required for each increase of 1 c.c. sodium citrate c.c.
1	5	0	7	2.0	—
2	5	1	6	2.3	0.3
3	5	2	5	2.6	0.3
4	5	3	4	2.85	0.25
5	5	4	3	3.2	0.3
6	5	5	2	3.45	0.25
7	5	6	1	4.00	0.55
8	5	7	0	4.30	0.3

An examination of the individual cases treated with milk mixtures containing sodium citrate showed that in those cases in which the acidity of the stomach was low practically all the hydrochloric acid was converted into sodium chloride, while in those of high acidity

Protein digestion in the stomach of the young infant would appear to be very slight and such as does occur to be in fairly direct proportion to the amount of acid present.

PRACTICAL APPLICATION. A practical application of these results is suggested in connection with the class of infants who vomit persistently from birth. According to these results these cases, while showing no especial clinical differences, may be divided into two fairly definite groups according to the acidity of their gastric contents. If the hyperacidity found in the majority of these cases is the chief cause of their vomiting the fact of the excess of acid and its degree should be known in order that the treatment may have a rational basis. The administration and removal of a test feeding in a young infant is a simple procedure, the greatest difficulty being the finding of the most appropriate substance to be used. A simple five per cent. solution of lactose in water has shown the most striking differences between the acid content of the stomach of individual infants and appears to be the most suitable feeding to test the gastric contents. It might, however, be well to follow this test after a day by a second examination in which a mixture of cow's milk, one part to water two parts is used. By this means the stomach both in comparative rest and during active digestion may be studied and the amount of acid actually secreted, owing to the stimulation of the milk, determined. It seems probable that the results of such findings will give some important indication for treatment. When the acidity is low, a weak alkali to stimulate acid secretion or possibly a few drops of dilute hydrochloric acid will be indicated, whereas if an oversecretion of hydrochloric acid is found, either a higher protein meal, thereby binding more of the acid, or sodium citrate to convert the hydrochloric acid into sodium chloride may be found effective. The accurate knowledge of the degree of acidity may be of especial value in cases of congenital pyloric stenosis or pylorospasm. In the one case we have had the opportunity to examine, the gastric acidity was exceptionally high. This agrees with the findings of Knoepfelmacher, Engel, and others. If, as seems probable, the pylorospasm is due to the hyperacidity, an accurate knowledge of its degree must be of no little value in treatment.

SUMMARY. 1. The motility of the infant stomach varies inversely to the concentration of the food. The more dilute the food the more frequently may the feedings be given.

2. Lime water does not reduce the acidity of the gastric contents, the neutralizing of a portion of the acid being overcome by an

the amount of the fixed chlorides was increased by a fairly definite amount, namely 0.043 per cent. A calculation of the amount of hydrochloric acid which should theoretically combine with 0.2 per cent. sodium citrate shows that one would expect 0.061 per cent. Allowing for the increased dilution from the gastric juice it would seem that the 0.043 would approach rather nearly the theoretical amount and that, therefore, the combination of HCl with sodium citrate in the stomach closely follows chemical laws.

increased stimulation of hydrochloric acid by the gastric glands. This may even increase the amount of acid available for digestion.

3. Sodium citrate acts on the acid in the stomach converting it into sodium chloride and thus markedly reduces the "available hydrochloric acid."

4. Barley water seems to have no constant effect upon the chemistry of gastric digestion in the infant.

5. The type of infants who vomit persistently may be divided into two classes, hypoacidity and hyperacidity.

6. Test feedings should be given to this type of infants to determine to which class they belong.

7. A five per cent. milk sugar solution seems to be the most satisfactory feeding to determine fine differences in the gastric contents. This may be followed by a mixture of milk one part, water two parts, to determine to what extent the gastric glands are capable of responding to stimuli. For the lactose solution thirty minutes is the most satisfactory time to allow the feeding to remain in the stomach; for the milk mixture sixty minutes.

8. On purely theoretical grounds it would appear that when the acidity is low either small doses of alkalies or of hydrochloric acid are indicated while in hyperacidity sodium citrate holds out the best hope of benefit.

9. Protein digestion in the infant's stomach is slight and is proportional to the amount of hydrochloric acid in the organ.

I desire to express my thanks to Dr. L. Emmett Holt for the inspiration and the many valuable clinical suggestions given during the course of this work; to Dr. P. A. Levene for his aid in directing and overseeing the chemical side of the problem; and to Dr. Hemenway, resident physician, her assistants, and the nurses of the Babies' Hospital for their coöperation and kind assistance.

BOILS: A NOTE ON THEIR TREATMENT.¹

By GEORGE THOMAS JACKSON, M.D.,

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Not long ago ringworm was regarded as a constitutional disease, and rules were given as to the general treatment of the patient in order to effect a cure. This ancient tradition still lingers, in so far as some doctors still insist that ringworm of the scalp is more obstinate in strumous than in other patients, and in them constitutional

¹ Read at a meeting of the Alumni Association of the City (Charity) Hospital, New York, January 13, 1909.

treatment is important, if not essential, for its cure. There is no doubt that ringworm is a purely local infection by some form of the trichophyton, and has nothing whatever to do with constitutional states. As the trichophyton is a vegetable fungus, it will grow better in some soils than in others, and so some people are more susceptible than others to infection by it. What the peculiar condition of the soil is we do not know. We do know that at the age of puberty some change takes place in the scalp that renders it no longer a proper soil for the growth of the trichophyton, and a ringworm that has long been on the scalp disappears even without treatment. We also know that ringworm is practically never seen on the scalp of an adult.

Boils, likewise, have nothing to do with constitutional states, but are due to local infection with staphylococci. We see them breaking out as small epidemics at times. Some rowing crew composed of young men in superb physical condition develops such an epidemic. One of their number contracts a boil on his hand, and others of them get boils from handling the oars. Surely here is no vice of constitution, but a pure infection. Boils are most often seen on the back of the neck. Surely there is no constitutional condition conceivable that would cause them to limit themselves to that region. They appear there simply because the back of the neck is subject to slight traumatism, as from the rubbing of a rough collar or a collar button, and this gives the chance for the pus organisms to find entrance into the skin. Boils are frequently seen in diabetes, in which there is a grave constitutional disorder. But they are seen frequently also in scabies, in which there is no question of a constitutional disorder. In both instances their presence is due to the slight traumatisms of the skin caused by the scratching to relieve the itching, and the consequent opportunity for the entrance of the pus organisms.

It need not surprise us that boils are as frequent as they are. The surprise is that they are not more frequent than they are, the special fungus being so common that it is often found on damp cloths hung up in a room. The only explanation of their comparative infrequency is that, as in ringworm of the scalp, there is some peculiarity of the tissues of some individuals that makes them more susceptible to infection, while the majority of individuals are protected by an absence of such peculiarity.

Perhaps it may be asked: "How about crops of boils of which we hear so much?" Crops of boils are due most always to bad treatment of the first boil. When a boil developed from the infection of a skin follicle, the old and classic method was, and is, to poultice the boil, and when it came to a head, or "pointed," to open it with a crucial incision, squeeze out the pus, and replace the poultice. When we consider that a boil is due to a vegetable fungus somewhat like the yeast plant, how could we do better to cause it to grow

luxuriantly than to supply it with heat and moisture? And if we desired to produce a crop of boils, how could we do better than to smear the warm, moist surface with a pure culture of the fungus, as we do when we squeeze the pus over the surface of the skin after opening the boil?

Again, we meet with cases in which boils appear on different parts of the body. This condition is called furunculosis. It does not mean that there is any constitutional infection, but simply a transference of the common infection from one part to another by the fingers, or something else, in a person who is susceptible to the infection. It is true that this form of boils occurs at times in persons who are in poor general health, who on that account have their resistance to infection lowered. But still the sole cause of the boils is the local infection.

For a quarter of a century I have treated all boils, no matter where located, according to the method taught me by my friend Dr. George H. Fox. Scores of such cases have been treated by me both in public and private practice with uniform success. Though I have gone over the literature of the subject, I have found no mention of the method. As it is simple, safe, and effective, no excuse is necessary for making it the subject of this communication.

For the treatment of boils all that is necessary is a small piece of stick sharpened to a fine point, a little absorbent cotton, a 95 per cent. solution of carbolic acid, and a 5 or 10 per cent. ointment of salicylic acid. As soon as the boil has pointed, and it has usually done so when the patient comes to us, a small bit of the cotton is wound about the pointed stick, dipped in the carbolic acid, and bored into the softened point of the boil. This gives a chance for the pus to escape and thoroughly disinfects the cavity of the boil. The boil is not to be squeezed. The surface of the skin in the neighborhood of the boil is then washed over with peroxide of hydrogen, or a solution of bichloride of mercury, 1 in 1000, and the salicylic acid ointment spread on old washed cotton or linen cloth, or several thicknesses of gauze, laid over the boil and the adjacent region. That is the end of that boil, as a rule. If it is a very large boil, the operation may have to be repeated the next day. The ointment is to be kept constantly on the affected part for a week. Of course, a few new boils may appear for a few days in the region, the result of the infection of the skin follicles before this treatment was instituted. They are to be treated in the same way, and a cure will soon be attained.

If a patient comes to us before the boil has pointed it may be aborted by injecting into it a drop or two of a 5 to 10 per cent. solution of carbolic acid, or touching its top with 95 per cent. carbolic acid, while the above-mentioned salicylic acid ointment is used as a dressing.

There is no question that warm poulticing will relieve the pain of a boil, because it relieves tension of the skin. If such a dressing is thought to be necessary there is no harm in using compresses of hot boric acid solution. It is not necessary if the boil is punctured with pure carbolic acid, because the acid produces anesthesia in a few moments. Many times have I seen patients who have been kept awake for nights by the throbbing pain of the boil, go home and sleep quietly after the carbolic acid has been used.

As cases illustrative of the results of the treatment here advocated I would cite the following:

CASE I.—Man, aged forty years. Ten days before I saw him a boil appeared. He had poulticed it, and a second boil had formed. I injected three drops of 10 per cent. solution of carbolic acid into the new boil, and bored into the old one with pure carbolic acid. Over all a 10 per cent. ointment of carbolic acid was placed. Prompt and complete recovery.

CASE II.—Girl, aged nine years. She had a boil the size of a small cherry over her right eye. It was swabbed out with pure carbolic acid and covered with a 5 per cent. ointment of salicylic acid. Prompt and complete recovery.

CASE III.—Woman, aged sixty years. For about three years she had had a succession of boils about her head and neck. The above treatment was used. She made a prompt and complete recovery, and had no new boils for eight months, when I lost track of her.

CASE IV.—Man, aged forty years. He had had a series of boils for four months. After they had been treated as above he made a prompt and complete recovery.

CASE V.—Man, aged eighteen years. He had his first attack of boils one year before he came to me. It lasted under the old method of treatment for three or four months. Three weeks before he came to me the boils had begun to appear. Under the above treatment he promptly recovered.

CASE VI.—Man, aged forty-eight years. He had had a boil on the end of his nose for three weeks, which had been lanced. One application of the carbolic acid followed by the salicylic acid ointment ended the trouble in a few days.

CASE VII.—Man, aged thirty-seven years. He had had a series of boils on the back of his neck and hands for fifteen months. He had them lanced, dressed with bichloride solution, poulticed, and had taken yeast and many kinds of medicine from many physicians. When I told him he would be well in three or four weeks without taking any medicine, he laughed at me. In two weeks all the boils had disappeared. One month afterward one small one came, which also became well under one application of the acid. Nine months after, he came to me at my request and reported that he had had no more boils.

It will be noted that in all these cases not one drop of medicine was given by the mouth. I commend this treatment, asking that it be tried, and being sure that one will be convinced of its efficacy. It has one not small advantage over the usual surgical plan of incision, which is that it leaves a hardly appreciable scar. Thus, the patient escapes bearing a cross on the back of his neck for the rest of his life and advertising the fact that he once had a boil.

Opsonins and vaccines now occupy the centre of the medical stage. I do not deny their value, and in an extensive case of furunculosis I would use them. But in the usual run of cases what is the use of going to the trouble and expense of using them, when such excellent results can be obtained by using a pointed piece of wood, a minute amount of absorbent cotton, a drop of 95 per cent. carbolic acid, and a few cents worth of salicylic acid ointment?

REVIEWS.

MEDICAL GYNECOLOGY. By HOWARD A. KELLY, A.B., M.D., LL.D., F.R.C.S., Professor of Gynecological Surgery in the Johns Hopkins University, Baltimore. Pp. 662; 163 illustrations. New York and London: D. Appleton & Co., 1908.

"It will be my effort in the following pages to review my special field, in an endeavor to return to the general practitioner that portion of it which he ought to recover by right of his prior lien." This quotation from the preface of the volume before us gives its keynote. Some will feel, we believe, that the author has tried to return more than is wise, but be that as it may, he has produced a most valuable book which fills a long felt want. His first chapter of forty pages is devoted to the consideration of the various methods of conducting the gynecological examination, together with a consideration of some of the more common symptoms. In this connection he takes occasion distinctly to place himself on record as opposed to indiscriminate operative correction of uterine displacements for the relief of backache by the epigrammatic statement that, "from backache to uterus in women and backache to kidneys in men is a fallacious mode of reasoning." We are also glad to call attention to his belief that, as a rule, coccygeal operations are failures from the standpoint of the relief of pain. On the other hand, we are sorry to note his dictum that the operation for the repair of the lacerated cervix is generally a most useless procedure. The two following chapters upon the hygiene of infancy and girlhood, and normal menstruation and the menopause are most excellent, and the former is particularly to be recommended to the perusal of all physicians bearing the responsibility of family practice. The consideration of dysmenorrhœa is, in the main, all that could be desired, although we fail to see why the author has included in his treatment the use of the intra-uterine electrical applications. Admitting that this may be a permissible therapeutic agent to the trained specialist, we must strongly deprecate its use by the men for whom this book was specifically prepared. Neither do we believe that it is advisable that the general practitioner be encouraged to perform the "simple" operation of cervical dilatation and curettage of the uterus. The training necessary to the proper selection of cases suitable for the procedure, together with the necessity for surgical cleanliness, removes this operation from

the domain of medical practice. The chapter upon intermenstrual pain, together with those upon amenorrhœa, menorrhagia, and metrorrhagia, are most satisfactory, and his statement that, in the treatment of hemorrhage in young or unmarried women, the use of douches and local treatments is "gynecological tinkering" would form a good motto for many an office even at the present day; its observance, we fear, would considerably deplete the income of some of our brethren. We are delighted to see that in his consideration of the treatment of extra-uterine pregnancy there is no place given to the "waiting policy." The consideration of the general subject of constipation is most careful and thorough, and will well repay careful study, since it must be admitted that much bad advice is prevalent. Those of us who have passed through the period when active post-operative purgation was considered an essential will be most enthusiastic in regard to the mild measures enjoined by the author for the treatment during this trying time, particularly if we have had any actual knowledge in our own person of the more heroic earlier methods.

In his especially pleasing chapter upon backward displacements of the uterus it is a pleasure to find that that valuable little instrument, the pessary, receives adequate and respectful treatment. The statement that the so-called Alexander operation is gradually going out of fashion among gynecologists will be questioned in some quarters. The chapters upon pelvic inflammatory disease, sterility, gonorrhœal infection, and syphilis are as valuable as the extended experience of the author would lead one to expect. To the last mentioned subject he has devoted fifty pages. This, in a book of this nature is remarkable, but very praiseworthy, since among general practitioners there is a lamentable lack of practical knowledge upon all phases of this subject, except the general appearance of the primary lesion in the male, and the dose of protoiodide. Chapters upon abortion and the injuries and ailments following labor are replete with interest, and it is needless to state that the advice given is sound, although we feel that there is a good deal of ground to conclude that the operation of curettage of the partly emptied uterus is as much the operation for the specially trained man, we do not say the specialist, as are any of the simpler abdominal operations. The chapters upon fibroid tumors and carcinoma are complete presentations from the non-operative standpoint, and the emphasis placed upon the need for the education of women in the matter of the importance of early medical attention in all suspicious cases is to be especially praised. The limit of operative interference has been reached, it would seem, and any betterment in operative results depends upon the diagnostic ability of the general practitioner and the dissemination of knowledge among women. There may be some question as to the proper method, but no intelligent physician can escape the conviction that the laity should be trained to recog-

nize the early symptoms of this disease. In the chapter upon cystitis the author gives in detail the method used by himself in cystoscopic examinations of the bladder. We know that Dr. Kelly is most expert in the use of the instrument that bears his name, but we doubt whether it is feasible to expect that anyone who does not make a practice of examination of the bladder can in the occasional case expect to get any results by the use of the instrument advocated. We moreover doubt very decidedly whether anything but harm would result by the adoption of the cystoscope as a part of the office armamentarium of the general practitioner. In any event, we feel from personal experience that for inspection of the bladder and catheterization of the ureters, one of the electric instruments with water distention will give better results after a much less tedious training. The chapter upon the functional nervous diseases most commonly seen by the gynecologist is a much needed chapter. The author is to be congratulated that it has been included. The volume concludes with chapters upon appendicitis in its relation to disease of the pelvic organs, splanchnoptosis and movable kidney, and post-operative conditions. In brief, the book is a most thorough and satisfactory exposition of non-operative gynecology, written from the standpoint of actual personal experience. It should be not only in the library of every general practitioner, but should be carefully read from cover to cover.

W. R. N.

BIER'S HYPEREMIC TREATMENT IN SURGERY, MEDICINE, AND THE SPECIALTIES. By WILLY MEYER, M.D., Professor of Surgery in the New York Post-Graduate Medical School and Hospital, and PROFESSOR DR. VICTOR SCHMIEDEN, Assistant to Professor Bier in the University of Berlin, Germany. Pp. 209; 95 illustrations. Philadelphia. W. B. Saunders Company, 1908.

THIS manual was written by the authors in order to supply a demand apparent to them for a brief and comprehensive description of the hyperemic treatment that would enable the surgeon, specialist, and general practitioner to become familiar with the method. The term "Stauungshyperämie" is taken over from the German language because the authors failed to find any word in English which would exactly cover the principle of the procedure. They object to the usual terms stasis, obstructive, congestive, induced, passive hyperemia, etc., as expressing but poorly the cause and physiological effect. The advantages of the method are well known, and it has been exploited for the last few years in many publications by Bier and his pupils. The book comprises the methods of induced hyperemia, general rules for its application and

its clinical use in surgery, medicine, gynecology, obstetrics, otology, ophthalmology, rhinology, pharyngology, laryngology, neurology, psychiatry, and dermatology. From this formidable list, which embraces nearly every condition that can be imagined, with the exception of certain infectious diseases, it will be seen that despite the statement of the authors that hyperemia is not to be considered a panacea, the wide range of diseases in which it is recommended will make it seem so, especially to the superficial observer. The methods of application are lucidly described, the illustrations are clear and descriptive, and the indications generally are well defined, but it does seem as though such an undercurrent of enthusiasm governs the statements of the authors as to cause some doubt of their claims. It need only be mentioned that the method is recommended in the treatment of cerebrospinal and spinal meningitis, diphtheria, burns, and even in cases of inoperable sarcoma and carcinoma to realize the extent to which enthusiasm will carry an advocate of a treatment which has a special action. As to the book itself, there is little to say except in commendation, although more attention might have been given to the theory of the method.

G. P. M.

PROGRESSIVE MEDICINE. A Quarterly Digest of Advances, Discoveries, and Improvements in the Medical and Surgical Sciences. Edited by HOBART AMORY HARE, M.D., Professor of Therapeutics and Materia Medica in the Jefferson Medical College, assisted by H. R. M. LANDIS, M.D., Demonstrator of Clinical Medicine in the Jefferson Medical College, Philadelphia. Vol. I, 1909, pp. 277. Philadelphia and New York: Lea and Febiger, 1909.

THE first volume of *Progressive Medicine* for this year begins with an excellent critical discussion, amounting to 114 pages, of recent progress in the surgery of the head, neck, and thorax, by Charles H. Frazier. Special attention has been devoted to cerebral trauma, cranial defects in epilepsy, brain tumors, hydrocephalus, abscess of the brain, the cranial nerves, diseases of the jaw, carcinoma of the lip, torticollis, Ludwig's angina, glandular enlargements and tumors of the neck, disorders of the thyroid gland, including exophthalmic goitre, diseases of the parathyroid glands, diseases of the œsophagus, diseases (especially tumors) of the mammary gland, empyema, bronchoscopy, the surgery of the heart, and a wide range of other diseases. Robert B. Preble devotes 52 pages to infectious diseases, including epidemic disorders and the relationship thereto of milk infection, cerebrospinal fever, diphtheria, dysentery, influenza,

malaria, the plague, pneumonia, rheumatism, scarlet fever, typhoid fever, etc. Floyd M. Crandall devotes 31 pages to recent progress in diseases of children, discussing especially the mortality rate in infants, ophthalmia neonatorum, congenital laryngeal stridor, arthritis, rickets, dentition, recurrent vomiting, and feeding. D. Braden Kyle discusses rhinology and laryngology, particularly recent progress in atrophic rhinitis, nasal obstruction and irregularities of the teeth and palate, diseases of the accessory sinuses, intracranial diseases of nasal origin, foul breath, adenoids, diseases of the tonsils, stuttering, tracheotomy, etc. Arthur B. Duel discusses diseases of the ear, especially suppurative labyrinthitis, brain abscess, the surgery of the facial nerve, cholesteatoma, the mastoid operation and its after-treatment, and the changes in hearing that occur in advanced life. The volume, as a whole, well fulfils the intentions of the editors, and may be commended as a virtual necessity to the practitioner who desires to keep abreast of the progress of medicine.

A. K.

A GUIDE TO THE CLINICAL EXAMINATION AND TREATMENT OF SICK CHILDREN. Second edition, greatly enlarged and rewritten. By JOHN THOMSON, M.D., Physician to the Royal Edinburgh Hospital for Sick Children, Joint Clinical Lecturer on the Diseases of Children, University of Edinburgh. Pp. 629; 160 illustrations. Chicago: W. T. Keener & Co., 1909.

THIS second edition of Dr. John Thomson's well-known *Guide*, which originally appeared in 1898, has been amplified to a size more than twice that of the original, and now appears as an imposing volume, beautifully printed and embellished with a profusion of half-tone illustrations. Founded upon a series of lectures delivered to classes of students and graduates attending the author's clinics at the Royal Edinburgh Hospital for Sick Children, the subject has been approached purely from a clinical standpoint, and thus the personal inspiration of the teacher can be traced clearly throughout the text, lending a touch of authority that serves to emphasize the salient facts and rivet the reader's attention. Differing thus from the construction of the usual text-book on diagnosis, the plan of the work adopts a more natural method of reasoning from the symptomatology as presented to the student who approaches a case as a problem and must work out his diagnosis from a comprehensive study of its clinical features. Appropriate stress is repeatedly laid upon the importance of using the eye in the clinical investigation of children's diseases, an art that is too apt to be neglected at the present day, when laboratory investigation can be so easily called upon for outside help.

Especial commendation must be given for the chapters on the diseases of the nervous system and of the digestive organs, which are unusually complete and are further illuminated by striking photographs of the facies of these diseases. Altogether this new edition offers a most helpful guide to the practitioner and student whose opportunities for the study of disease have been less extensive among children than among adult patients. It can be commended also as especially safe and temperate in its therapeutics, which reflects the seasoned experience of one of the most accomplished and widely known of British medical writers on pediatrics. T. S. W.

RETINITIS PIGMENTOSA, WITH AN ANALYSIS OF SEVENTEEN CASES OCCURRING IN DEAF MUTES. Being an Essay for which was awarded the Alvarenga Prize of the College of Physicians of Philadelphia, 1908. By WILLIAM T. SHOEMAKER, M.D., of Philadelphia. With Laboratory Examinations of the Blood and Urine by JOHN M. SWAN, M.D., of Philadelphia. 10 illustrations and three colored plates. Philadelphia: J. B. Lippincott Co., 1909.

THIS is an admirable essay, and with it and Nettleship's elaborate communication on Retinitis Pigmentosa and Allied Diseases, recently published, the reader is in possession of the fullest information on this interesting subject. Dr. Shoemaker has analyzed the extensive and often conflicting literature in such a way as to present briefly its best conclusions. He has added in an important manner to this literature by the record of seventeen cases of retinitis pigmentosa occurring in deaf mutes, and, with the aid of Dr. John M. Swan, has included the results of an investigation of the metabolism of the subjects of this disease which he himself has studied. The chapter on etiology is particularly good, and the interesting discussion on heredity and consanguinity in their relation to this disease is a good example of how much information can be given in a few well written paragraphs. Dr. Shoemaker concludes that heredity is a potent etiological factor, that parental consanguinity is of importance only in connection with heredity and environment, and that syphilis as a true cause of retinitis pigmentosa has not been established. He calls attention to the carelessness of the reports of many cases, and how frequently real retinitis pigmentosa and various types of pigmented chorioretinitis have been confused. He is in accord with the majority of observers that this disease is not an inflammation, and therefore deprecates the use of the term "retinitis pigmentosa," which, as he expresses it, should give way to the term "degen-

eration" or "sclerosis." While the laboratory investigations, which include thorough analysis of the blood and urine of the seventeen cases constituting the basis of this essay, made by Dr. Swan in the laboratory of physiological chemistry of the University of Pennsylvania, are most interesting, they have thrown no light on the nature of the disease, and, as Dr. Swan says, have been of no assistance in establishing its etiology or diagnosis. Dr. Shoemaker is much to be congratulated upon this essay, which is well worthy of the prize it received.

G. E. DE S.

HUMAN FOODS. By HARRY SNYDER, B.S., Professor of Agricultural Chemistry in the University of Minnesota. Pp. 362; 76 illustrations. New York: The Macmillan Co., 1908.

WRITTEN as a text-book for students who have taken a course in general chemistry, this book will be scarcely likely to find a place in the library of the physician. For those wishing a closer insight into the chemistry of foodstuffs and the changes these undergo during cooking and digestion, the volume may be of benefit; but as an aid to dietetics, or for use in general medicine, it will prove of little value. The author's style is clear, and even to those not acquainted with general chemistry the subject is readily intelligible. Some of the illustrations seem unnecessary, since a great many are unaccompanied by any explanatory note. For instance, Fig. 3 shows an apparatus for the determination of fat; but without a word of description the cut is meaningless, except to laboratory workers, and the picture of a flour mill (Fig. 39) serves no purpose and offers no illustration of the text. Criticism may be made of the author's failure to make use of the metric system, since this system is in general use in scientific work. Thus, on page 11 he says, "a pound (of starch) yields 1860 calories;" and in other places the Fahrenheit scale is used instead of the centigrade. Temperatures should be expressed in terms of both systems. To the laity, for whom this book is also written, the interchangeability of "proteid" and "protein" is most confusing; and since the latter word has been recommended by American physiologists and chemists, its use is to be preferred. The index is far from satisfactory, as not only is there no attempt at an alphabetical arrangement of subjects, but there are important omissions; for example, no reference is given to tyrotoxicon, which is described on page 85. With more careful attention to proofreading (on page 21 the author says, "One part of nitrogen is equivalent to 5.25 parts of protein," instead of 6.25), judicious elimination of some of the cuts and text, and a revision of the index, the book will be of value to those for whom it is especially written—students of agricultural chemistry.

E. H. G.

VENOMS, VENOMOUS ANIMALS, AND ANTIVENOMOUS SERUM THERAPEUTICS. By A. CALMETTE, M.D., Corresponding Member of the French Institute and of the Academy of Medicine, Director of the Pasteur Institute, Lille, France. Translated by F. E. AUSTEN, F.Z.S. Pp. 403; 125 illustrations. New York: William Wood & Co., 1908.

FOR fifteen years Calmette has carried on investigations upon the physiological action of venoms, and during this time a great number of papers have been published from his laboratory upon this subject. It seemed, therefore, advisable to collect these observations and summarize the results in book form. The entire question, however, is considered in the form of a treatise and the general literature upon the subject is fully utilized. The book, of some 400 pages, is divided into five parts, each containing several chapters. Part I is of an introductory nature and deals with the classification, habits, and detailed descriptions of the poisonous snakes. Part II is concerned with the chemical and physiological action of snake venoms. It is as one might suppose, one of the longest sections in the book, covering about 100 pages. In these chapters, the experiments which have lead up to the explanations of the poisonous action of the venoms upon the organs of the body and the blood, and the bacteriolytic and enzymotic properties of venoms are considered in a clear and satisfactory manner. This part and the following one on the antivenomous serum therapeutics is the section of the book which contains most of the results of the important investigations which have been made within recent years, for the remainder of the work is more or less concerned with zoölogical questions. Part IV, however, is very interesting and is devoted to a discussion of the venoms in invertebrates, fishes, and mammals. In these chapters many interesting facts are collected, and since the literature upon the subject is given in some detail, it forms a very valuable section. The book concludes with three "documents," which are in reality a series of case histories upon the treatment by antivenomous serum of human beings and domestic animals bitten by poisonous snakes. Besides the purely scientific discussions there are numerous short accounts of such subjects as the immunity of animals to snake bites and descriptions of the methods used by snake charmers in India and elsewhere. The book is fully illustrated and well translated.

W. T. L.

PROGRESS OF MEDICAL SCIENCE.

MEDICINE.

UNDER THE CHARGE OF

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A Clinical Method for the Serum Diagnosis of Syphilis.—NOGUCHI (*Munch. med Woch.*, 1909, lvi, 494) refers to the complexity of the Wassermann reaction and the practical impossibility of obtaining satisfactory results from it unless it is carried out by an experienced worker. A well-equipped laboratory is essential. Therefore the method cannot be applied as generally as would be desirable. The author has simplified the procedure and has attempted to devise a method which can be used by the general practitioner. He finds that filter paper may be impregnated with antigen and with serum which is hemolytic for human red corpuscles. A third paper may be prepared for the free complement, though it is safer to obtain this fresh from guinea-pig serum. By cutting the paper into pieces of appropriate size, the required amount of antigen, hemolytic serum, etc., is obtained. The technique of the method is given in detail and must be rigidly adhered to. In a series of two hundred cases parallel experiments with the original Wassermann technique and the new method showed the latter to be slightly more delicate.

The Mercurial Reaction as an Element of Diagnosis in Syphilis.—CURIONI (*Lancet*, 1908, ii, 1810) has made a study of the urine of syphilitic patients for the identification of mercury. He gave the patients 0.01 of perchloride of mercury hypodermically at 11 A.M. and examined the urine eight, fourteen, and twenty hours later. A positive mercurial reaction is the finding of mercury in the urine by the method of Vitali, namely, the isolation of the mercury by copper filings and the production with iodine of the yellow or the red iodide of mercury. In studying 30 syphilitic patients

and 20 non-syphilitic, he discovered that the elimination of mercury in the urine of the syphilitic is always much slower than in the case of the healthy individual. He found the reaction absent in cases of recent syphilis showing symptoms, and only a slight reaction, never so evident as in normals, in individuals in whom two or three years have elapsed since the primary sore. Finally, long-standing cases (ten to twelve years) of syphilis give as positive a reaction as normals. He explains the phenomenon by the hypothesis of the formation of a combination of the mercury and the syphilitic virus which does not readily pass through the renal filter. The combination results in the destruction of the virus. He has not applied the test to tabes and general paresis, but believes they will excrete mercury as readily as do normal individuals. He recommends the test to be of service in doubtful cases of syphilis for practitioners who are not trained to the more complicated technique of the Wassermann reaction.

Demonstration of the *Trichinella Spiralis* in the Circulating Blood in Man.—HERRICK and JANEWAY (*Arch. Int. Med.*, 1909, iii, 263) have confirmed the prediction of Staübli that the application of his method to man would result in its becoming a ready means of diagnosis of trichiniasis. His method consists in laking the blood from a finger puncture with 3 per cent. acetic acid, and examining the centrifugized sediment for the embryos. They were able to study the disease in a mother and seven daughters, in all of whom the diagnosis was made by the clinical findings of nausea, vomiting, diarrhoea, muscle pain, oedema of the eyelids, and the demonstration of an eosinophilia. In two instances trichinellæ were found with apparent ease in the laked blood of the mother. Herrick and Janeway lay stress upon this as the final proof of the distribution of *Trichinella spiralis* by way of the blood stream. They believe examination of the feces practically fruitless as a means of diagnosis, and hope this method of Staübli will prove a more ready and less painful diagnostic method than the excision of muscle.

Mitral Stenosis and Congenital Malformations.—J. HEITZ and A. LÉZARY (*Arch. d. mal. d. cœur, d. vaisseaux, et d. sang*, 1908, i, 701) call attention to the frequent association of mitral stenosis and various disturbances in mental and physical development. They agree with those authors who believe that this co-existence is proof of a congenital origin dependent upon some toxic or infectious cause, and they point out the need of demonstrating such arrested or anomalous physical developments as would date back to intra-uterine life. They emphasize the need of searching for such causes as syphilis, tuberculosis, or alcoholism in the parents. Only about fifteen cases in the literature fill these requirements; the malformations in these cases include imbecility, syndactylia (Dumolard), harelip (Marie), asymmetry of the base of the brain, ectopic testicles, and sternal malformations. To these cases they add two which have come under their own observations. The first was a man, aged forty-eight years, who had a pure mitral stenosis and a hemihypertrophy, involving the left arm and leg, which they considered traceable to intra-uterine life. The second, a better case, was a young man, aged seventeen years, an imbecile, with small testicles, a bifide uvula, and an anomaly in the union of the two rami of the lower jaw.

At the symphysis there was a median depression between two longitudinal ridges of bone. In the heart were the signs of a pure mitral stenosis. Neither of these patients had ever been ill. No other possible etiological element was apparent. However, no toxic or infectious cause was discovered in their parents. Two autopsies performed upon patients having mitral stenosis and congenital malformations seem to favor foetal endocarditis rather than arrested development in the production of the valvular lesion. In Faure's case the valve was thickened and indurated, with welding of the leaflets and hypertrophy of the chordæ tendineæ. Klippel and Clerc's case showed a slightly thickened valve and a patch of sclerosis. Heitz and Lézary interpret these thickenings and sclerosis as undoubted cicatrices of an old inflammation. Such an intra-uterine infection could be the cause of both the mitral stenosis and the arrested or anomalous development in the cases described.

Tuberculous Endocarditis.—DEGANELLO (*Il Policlinico*, December, 1908) reports the results of his attempts to produce a true endocarditis in rabbits by inoculation of the anterior chamber of the eye with tubercle bacilli after mechanical and chemical injury of the endocardium. In no instance was he successful. Nor did the intravenous injection of a mixture of tubercle bacilli and powdered charcoal cause inflammatory changes in either the parietal or valvular endocardium. He recalls the fact that Marchiafava, in a large series of autopsies upon tuberculous subjects, has never observed specific lesions of the endocardium. However, Landouzy and Gougerot (*Presse médicale*, 1908, xvi, 761) were able to produce a generalized tuberculosis in guinea-pigs by the inoculation of fragments of the injured valves from two cases of endocarditis in infants. In the first case the endocarditis was secondary to a pulmonary tuberculosis; in the second, it was a primary septicæmia. The lesions upon the valves consisted of mononuclear, fibrinous inflammations. No bacilli had been found in the sections.

Observations on Experimentally Induced Choked Disk.—CUSHING AND BORDLEY (*Johns Hopkins Hospital Bulletin*, 1909, xx, 95) state that their experience with over 400 cases of choked disks is in favor of a mechanical explanation of this condition rather than a toxic or inflammatory one. Their clinical observations have shown them (1) evidences of stasis in the eye grounds leading rapidly to a measurable œdema of the nerve head in cases of trauma, cerebral apoplexy, and simple cerebral œdema from concussion or contusion. In these cases the cause cannot be anything else but the mechanical influence of increased intracranial tension, operative relief of which leads to prompt subsidence of the congestion and œdema of the disk. (2) They believe that the condition of the eye grounds in cases of brain tumor and of nephritis is of a common origin, pressure, which in the latter case results from cerebral œdema. (3) They have seen a great number of instances of partial or total subsidence of choked disk after simple decompression, which more than any other factor, favors a mechanical rather than a toxic source of the neuroretinal change. By a series of experiments upon dogs they show that a neuroretinal œdema with marked elevation of the papilla accompany conditions which raise intracranial pressure whether from the introduction of new fluid under tension or from transmission

of tension to the fluid already present; and further, that a visible distention of the optic sheath occurs probably antecedent to the production of the neuroretinal change. Simple stasis in the retinal veins fails to produce anything more than the venous engorgement which accompanies a choked disk. It does not lead to a definite oedema of the papilla, the latter apparently requiring the concomitant action of fluid under tension in the optic sheath. They find that long continued pressure against a dural defect can lead to retinal hemorrhages and other clinical, as well as histological, features which characterize chronic choked disk in man. In conclusion, they state: (1) That the occurrence of the neuroretinal oedema is primarily dependent upon the passage of cerebrospinal fluid under tension from the subarachnoid spaces of the interpeduncular region into the vaginal sheath of the optic nerve, and that cerebral decompression often allows the process to subside, owing to a resultant diminution of tension from release of confined fluid. (2) That their experimental work corroborates many more recent clinical observations in showing that a choked disk, even of considerable height, may be rapid in its formation, and, provided it has not gone on to the stage of new tissue formation, may rapidly subside; and thus speaks strongly in favor of a mechanical, as opposed to a chemical or inflammatory, origin for the lesion.

Paralysis in the Left Recurrent Laryngeal Nerve in Mitral Affections.—OSLER (*Arch. d. mal. d. cœur, d. vaisseaux et d. sang*, 1909, ii, 73) states that there are two valvular affections of the heart which may give the impression of an aortic aneurysm. The first, aortic insufficiency, as Corrigan pointed out, suggests it by the marked pulsation of the arch of the aorta. The second, lesions of the mitral valve, is even more confusing. To the paroxysms of cyanosis and dyspnoea may be added a visible pulsation in the second left interspace close to the sternum and a paralysis of the left vocal cord. Ortner (of Vienna) was the first to describe the compression of the left recurrent laryngeal nerve between the aorta and a considerably dilated left auricle, in a patient in whom he had diagnosed aneurysm *intra vitam*. The majority of the cases have such a cause, but some few are due to compression by enlarged pulmonary veins or the left pulmonary artery.

Osler describes three cases within his experience, two of which were with autopsy. All three had signs of a double mitral lesion and paralysis of the left vocal cord. The second case gave a history of diphtheria, which, Osler emphasizes, may be the cause of the laryngeal paralysis in some cases. In this case, however, the change of voice antedated the attack of diphtheria. Autopsy in two of the cases showed the recurrent laryngeal nerve sclerotic and opaque in the portion compressed between the wall of the left auricle and the aorta.

A Simple Method for the Determination of the Diastolic Blood Pressure.—EHRET (*Münch. med. Woch.*, 1909, lvi, 606) alludes to the difficulty the general practitioner experiences in determining the diastolic blood pressure accurately. He describes a new method, which he has found accurate, simple, and easy of application. While the pressure is raised slowly in the cuff about the arm, one palpates the *arteria cubitalis* at the lower edge of the cuff. Without transition stages there will be felt,

very readily, a remarkable pulse wave, literally "springing up against the finger." The pulsation is so forcible that it is transmitted to the surrounding tissues. To the palpating finger the wave feels large, quick, and hard. In very fat, muscular arms, in which the arteria cubitalis is not readily felt, the phenomenon is somewhat more difficult to obtain. In such cases the finger is placed on the arm perpendicularly to the suspected direction of the artery. The pulse is perceived suddenly, and with it there is felt a pulsation communicated to the surrounding tissues. Many experiments have shown that the pressure at which this phenomenon occurs corresponds to that at which the greatest oscillation of the mercury column is seen.

Coagulation of the Blood in Thrombosis.—CHANTEMESSE (*Bull. méd.*, 1909, iii, 21) states that the coagulability of the blood is modified in the thromboses of cachexia, puerperium, hemorrhage, and infection. He increases the coagulating power of the blood by the calcium content determined by precipitation with increasing amounts of potassium oxalate. He believes calcium plays a rather active role in the coagulation process, and by following patients from day to day with this method he can prevent phlebitis or the formation of clots by administering such a decalcifier as citric acid.

Menstrual Hyperemia of the Liver.—CHVOSTEK (*Wien. klin. Woch.*, 1909, xxii, 293) points out an intimate relationship between the female sexual organs and the liver. The frequent occurrence of icteris gravis and acute yellow atrophy during pregnancy, the appearance of attacks of gallstone colic during menstruation, the influence which must be attributed to pregnancy in the formation of gallstones, the frequency of fatty livers in women at the menopause and after castration—all these facts indicate a close relationship existing between the organs of reproduction and the liver in the female. In the literature the statement is made that there is a hyperemia of the liver during menstruation, but the statement is apparently not based on careful observations. Chvostek has percussed the liver borders in thirty women during and after the menstrual period and found that the lower border descended one to two finger-breadths in all but three. The swelling was noted in healthy and diseased livers with about equal frequency. There is no pain on palpation or percussion, and the enlargement is probably due to hyperemia.

An Unusual Localization of Lead Poisoning.—TELEKY (*Allg. Wiener med. Zeitung.*, January 5, 1909) confirms the theory of Edinger that the first localization of a toxin is in those muscles and organs which are being overworked. He describes as supporting evidence two cases of lead poisoning. Two sisters were employed in a factory rubbing the metallic wrappers of bottles. In this work the thenar eminence of the right hand was used particularly. And these two women presented themselves with atrophy and paralysis of the muscles of this eminence. They both gave a previous history of lead colic and encephalopathy.

SURGERY.

UNDER THE CHARGE OF

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Precocious Typhoid Cholecystitis.—BOBBIO and GENNARI (*Archiv. gén. de chir.*, 1908, ii, 555) reports a case in which, five days after the first signs of typhoid fever developed, the patient began to have the signs of a very acute cholecystitis. Operation two days later showed a necrotic gall-bladder, and two days after the operation the patient died. Typhoid bacilli were found in the bile. Up to the present time typhoid cholecystitis has been found to be rare and to develop especially toward the end of the fever or during convalescence. The greater number develop between the tenth and thirtieth days. The infection in Bobbio and Gennari's case was traced as follows: The bacillus of Eberth first invaded the blood and gave symptoms of acute septicemia. It became localized in the gall-bladder, where it gave rise to an increase phlegmonous inflammation. Migration of the bacilli then followed into the intestine, whither it was carried by the bile. The portal of entrance into the organism is doubtful, as is always the case. The diagnosis of the complication is sometimes far from easy, and an exploratory laparotomy is sometimes necessary. The statistics of Quenu show that of thirty operations done for cholecystitis during typhoid fever, seventeen were cholecystostomies and five cholecystectomies. While the latter is the ideal operation, it is in the majority of cases very grave.

Methodical Exploration of the Urethra.—MOTZ (*Ann. de mal. des org. gén.-urin.*, 1909, i, 161) says that the patient should not pass urine for some hours preceding the examination. The urethra is then expressed, and the secretion obtained is examined bacteriologically. The patient now urinates into three glasses, and the urine is examined by the naked eye and microscopically. The meatus first and then the glans and prepuce are cleansed with cotton moistened with oxycyanurate or bichloride of mercury (1 to 1000). The urethra is then irrigated with the oxycyanurate of mercury (1 to 3000), containing a few drops of methylene blue, and the bladder filled. The region as far as the bulb and Cowper's glands is expressed and the patient asked to urinate 15 to 20 c.c. of the bladder fluid. This is examined for filaments or a cloudy fluid, and it is preserved for a microscopic examination. The patient then lies recumbent again and a methodical examination is made of the prostate, seminal vesicles, and membranous urethra. Their contents are expressed into the urethra, and the patient again urinates about 100 grams of the bladder fluid, this being divided into two glasses if it is cloudy. To the first should be added a few drops of

acetic acid, to see if the cloudiness disappears. If it persists, the second glass is kept for microscopic examination. The caliber of the urethra is then examined, beginning with a No. 25 exploring instrument. A larger bougie, No. 46, is then introduced into the urethra and the wall of the anterior urethra examined for any infiltration in it. If it seems to show an impalpable gonorrhœal focus, the urethra is massaged and the patient asked to urinate. The fluid obtained is retained and examined for trouble in the glands of the anterior urethra. All these explorations can be made at one sitting. Two or three days later a urethroscopic examination should be made. It is preceded by an irrigation of the whole urethra and filling of the bladder. When on account of a stricture or rebellious spasm of the urethra all the antiseptic precautions referred to above cannot be carried out, it should be borne in mind that every attempt at catheterization may prove septic, because of microorganisms in the normal urethra. After the examination is completed in such a case a small enough catheter should be passed into the bladder and a weak solution of silver nitrate (1 to 200) injected into the bladder and along the urethra. In this way the complications resulting from exploration are reduced to a minimum.

The Treatment of Severe Strictures of the Œsophagus by Œsophagotomy.—GUISEZ (*Archiv. gén. de chir.*, 1908, 562) says that of 28 cases of cicatricial strictures of the œsophagus, in 23 the normal caliber was reached and the patient returned to normal or nearly normal alimentation. In those cases in which failure resulted the strictures were entirely closed or a filiform could not be passed. The results were in all cases better the more recent the strictures. The short valvular strictures seem to be especially benefitted by this method. Multiple strictures offer no serious obstacles to endoscopy, each stricture being dilated successively. Long strictures with longitudinal infiltration alone are difficult to dilate and to keep dilated. The results, taken as a whole, are very satisfactory, since in four-fifths of the cases a cure was obtained, although in some a gastrostomy would have been the only palliative operation which would have prevented the patient from starving. Gastrostomy is itself not without danger, and in children it is rare that it gives long service.

Extravesical Suprapubic Prostatectomy.—STOCKUM (*Zentralbl. f. Chir.*, 1909, xxxvi, 41) says that the perineal operation is undoubtedly less dangerous than the suprapubic, but that it has the disadvantage of leaving behind, occasionally, rectal and urethral fistulæ. Stockum did the following operation in two cases with good results. The patient was anesthetized and placed in a marked Trendelenburg position. A soft catheter was placed in the empty bladder and a median suprapubic incision made. The prostate and beginning of the urethra were rendered visible by passing between the symphysis and bladder, and hooking the anterior peritoneal fold upward with the finger. A small opening was made in the highest portion of the capsule of the prostate, which could be enucleated through this opening without working through the bladder, the catheter in the urethra helping to locate the latter. During this stage the prostate was pushed upward by the finger of an assistant in the rectum. There was considerable bleeding, but a gauze

tampon inserted controlled it. To drain the urine from the bladder a small buttonhole was made in the summit of the bladder and a rather thick drainage tube introduced and fixed to the bladder wall by a catgut suture. The abdominal wound was closed down to the tube and gauze drainage introduced. The urine was conducted to a glass bottle at the side of the bed containing a 1 to 1000 bichloride solution. The hemorrhage was free for a few hours, but stopped spontaneously. The urine flowed freely and was slightly blood stained. The large gauze drains were removed on the second day and were replaced by strips of gauze. The bladder was washed out daily with a weak silver nitrate solution through the drainage tube. On the fifth day the gauze and rubber drains were removed and a silk catheter introduced through the urethra. This was removed on the twelfth day, when the bladder and urethral wounds were closed and the patient urinated spontaneously. Stockum considers that this operation is more simple than the Freyer and makes a smaller wound. Blood is not so likely to get into the bladder as in a Freyer operation, and, therefore, the catheter is not so likely to become obstructed by blood clot.

Apparently Strangulated Herniæ.—CLAIRMONT (*Archiv f. klin. Chir.*, 1909, lxxxvi, 631) says that an apparent strangulation of an external hernia may result from a mechanical or paralytic ileus. An inguinal, femoral, or umbilical hernia, free until that time, may become irreducible and somewhat painful and tense. The simultaneous existence of signs of intestinal obstruction may lead to the diagnosis of an incarceration of the external hernia. The changes in the hernia, however, depend upon and are secondary to the intra-abdominal trouble. Damage may be done to the hernial contents, now irreducible, in view of the crowded condition of the sac and the increasing distention of the intestine within. The causal relations may be reversed, that is, a primary incarceration may be followed by a second intra-abdominal occlusion of the bowel. The most important evidence showing a strangulation is to be found in the slight degree of tension and pain in the hernia. The condition which underlies the false strangulation or is merely associated with a real strangulation, may be determined to be a mechanical or a paralytic ileus, but only in rare cases can it be exactly diagnosed. If a supposed strangulated hernia be wrongly diagnosed and be operated on, the herniotomy will occasionally indicate, by the atypical findings, an intra-abdominal complication. If the symptoms of ileus persist after the operation or reduction of a supposed incarcerated hernia longer than twenty-four hours, one should think of an unrelieved mechanical or paralytic ileus. The prognosis of these cases is unfavorable. Improvements can result only from a proper interpretation of the clinical picture, early surgical intervention, and exact attention to the anatomical findings. The best treatment is a hernio-laparotomy.

The Extirpation of Brain Tumors in the Motor Cortical Area.—MIYAKE (*Archiv f. klin. Chir.*, 1909, lxxxviii, 811) says that there are three principal views as to the operative treatment of brain syphilis. The supporters of the first say that operative treatment should be rejected and antisiphilitic treatment exclusively recommended. This is the view

of most neurologists and internists. According to the second, operative treatment is indicated only under certain circumstances, chiefly after the failure of antisyphilitic therapy. Most surgeons and a few internists entertain this view. According to the third view, all antisyphilitic treatment should be rejected and only operative carried out. An analysis of the cases of brain syphilis operated on shows that the diagnosis has not always been correctly made or the exact situation of the tumor established, but the operations were done upon the doubtful diagnosis of brain tumor and a syphiloma accidentally found, as in Miyake's case. He thinks that when the internal treatment fails, and the syphilitic tumor is favorably situated, it should be operated on, as the permanent results will be better. In his patient antisyphilitic treatment continued for fifty days was entirely without results. Extirpation was followed by strikingly prompt success. The patient not only recovered quickly, but showed only insignificant functional disturbances in the affected limb, and these later disappeared.

Experimental Investigations Concerning the Preventive Influence of Hirudin upon Coagulation of the Blood in Animals.—RIMANN and WOLF (*Deut. Zeit. f. Chir.*, 1909, xcvii, 177) carried out their experiments to determine whether by the introduction of drugs into the circulation, the development of thrombosis could be hindered. They employed for this purpose hirudin, the value of which in preventing coagulation was first demonstrated by Havercroft in 1884, and which has been more recently studied by Peckelharing and others. Rimann and Wolf concluded from their studies that in order to delay the coagulation of circulating blood for a certain time, in small dogs, it was sufficient to inject intravenously a quantity of hirudin, which would give 0.005 gram for every 50 c.c. of blood. The time during which the preventive action on coagulation of this dose (half the normal dose) lasted was between one and one-half and three and three-quarter hours. With an intravenous injection of 0.019 of hirudin for every 50 c.c. of blood (normal dose), coagulation occurred first after four and one-half hours. Subcutaneous injection of hirudin exerted no influence upon the coagulability of the blood. Injurious influence of the hirudin in the established dose upon the general condition could not be determined.

Congenital Dislocation of the Lower End of the Ulna.—ROBINSON and JACOLET (*Archiv. gén. de chir.*, 1909, iii, 1) says that with regard to the pathogenesis of congenital luxation of the lower end of the ulna we ought to take into consideration two factors, the anatomical and mechanical. The anatomy shows us that the radial incurvation and posterior luxation of the lower end of the ulna are only an exaggeration of a congenital disposition of the bones and inferior radio-ulnar articulation. The congenital tendency existing, the deformity is accentuated by the muscular contractions applied in the occupation of the patient. According to this theory the intervening cartilage undergoes modifications purely mechanical. It is possible that sometimes there may be an infectious lesion of the cartilage, but up to the present time this has not been demonstrated. The kyphosis of the carpus presents some analogies with genu valgum on the one hand, and congenital dislocation of the hip on the other. There are only a few chances that surgical intervention will prove really efficacious.

THERAPEUTICS.

UNDER THE CHARGE OF

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The Action of Intravenous Injections of Strophanthin in Heart Disease.—DANIEL POLI (*Archiv. d. mal. d. cœur.*, 1908, xi, 609) has given intravenous injections of strophanthin in 23 cases of heart disease with very encouraging results. He believes that strophanthin is one of the best heart stimulants, not only because of the rapidity with which it acts, but also because of the possibility for securing accurate dosage and because its action is exerted exclusively upon the heart. He used 0.001 gram ($\frac{1}{64}$ grain) of the strophanthin, repeating the dose at intervals of twenty-four hours, for several days if necessary. As a rule, one or two injections were all that was necessary. It acts more rapidly than any other known heart stimulant, he says, increasing the force of the contractions, slowing the pulse, raising the arterial tension, and increasing the amount of the urine notably. Consequently the œdema and the passive congestion of the viscera soon subsided. These effects were especially marked when there was no advanced kidney lesion. When the kidneys are markedly deficient, strophanthin is useless unless combined with diuretics. In a few cases good results were obtained by the combined administration of theobromin by mouth and strophanthin intravenously. For this reason he believes, with Lust and Hoepffner, that the injection of strophanthin may serve to differentiate whether the trouble is a primary cardiac failure or heart failure secondary to an advanced nephritis. He had no complications, such as fever or chills, after the intravenous use of strophanthin, and believes that they can be avoided by strict asepsis.

The Treatment of Degeneration of the Myocardium with Intravenous Injections of Strophanthin.—FLESCH (*Wien. klin. Woch.*, 1908, xvi, 1590) reports only a single case, but the benefit was so striking after the failure of all other heart stimulants and diuretics that he cannot refrain from attributing some credit to the strophanthin. He used 0.001 gram intravenously at intervals of two or three days. He was able by this treatment to keep his patient in good condition for months.

Atropine in the Treatment of Bronchial Asthma.—TERRAY (*Med. Klinik.*, 1909, iii, 79) speaks for the wider use of atropine in the treatment of bronchial asthma. He believes it exceedingly valuable for certain cases, especially those with a marked neurotic element. Terray cites the histories of seven severe cases of bronchial asthma treated by atropine with very encouraging results. In one of these cases he not only succeeded in arresting the acute attacks, but the patient was so much improved that there was no recurrence of attacks for ten months.

Previously, this patient had been constantly affected for twenty years. He prescribes atropine in pills, each pill containing 0.0005 gram ($\frac{1}{2000}$ grain). He gives one pill a day at first, then, after two or three days, gradually increases the dose to a total of from four to six pills a day. When this amount has been reached, he gradually reduces the amount to one pill a day. Terray believes that atropine not only will arrest an attack, but it also will prevent a recurrence. One great advantage is that atropine can be advantageously used as a substitute for morphine or may be alternated with morphine.

The Limitations of the Treatment of Neuralgia by Injection.—SCHLESINGER (*Med. Klinik.*, 1908, xlix, 1868) has been using physiological salt solution just below the freezing point for the local treatment of neuralgia. The advantages of the chilled solution are the small volume of the injection and the immediate relief to the pain, which is most encouraging to the patient. He cites sciatica as a type of painful nerve affection in which many observers have reported beneficial effects from the injection therapy. He believes that many cases of sciatica which have been reported as cured or benefitted by the injection treatment are of questionable diagnosis. He insists that an accurate diagnosis is essential, and believes that all cases of acute sciatica and the majority of the chronic cases do not improve under the injection treatment. Such cases should be treated by rest in bed, quinine in small doses, and galvanization. The latter should not be begun too early. Schlesinger gives the distinguishing features of true sciatica, and also calls attention to the fact that sciatica may be a gouty manifestation and yield to appropriate treatment for gout.

Furthermore, he believes that intraneural injections are dangerous for mixed nerves like the sciatic. He has seen paralysis result from such an injection. Schlesinger describes an affection which he considers different in many ways from true sciatica and which is very amenable to injection therapy. This begins gradually with a little sensitiveness in the hip, vague drawing sensations which only gradually develop into intense pain, whereas sciatica, as a rule, develops suddenly. Furthermore, this non-sciatic pain does not follow the course of the sciatic nerve, but spreads over the surface from the crest of the ileum to the spine. This pain area may be as large as the palm of the hand, and the overlying skin is always hyperesthetic to a greater or less degree. This group of symptoms differs considerably from sciatica, in which complaint the skin is usually less sensitive than normal. Furthermore, these areas are not innervated by the sciatic nerve. He believes that this trouble is due to a neuritis of the smaller nerve fibers in the muscles, and that the pain is produced by traction upon the periosteum by the contraction of the muscle bundles. The localization of the most painful area at the crest of the ileum at the insertion of the muscle can be thus explained. This affection can be cured by the injection of any of the different solutions advised for the purpose, such as the injection of 50 to 100 c.c. of an 8 per cent. salt solution with a little cocaine, the Lange technique; the injection of the same solution at different points, the Peritz technique; the injection of 10 c.c. of Schleich's solution, Alexander's method; or by the injection of 10 c.c. of salt solution just below freezing point, which is Schlesinger's method. Schlesinger

condemns the use of alcohol injections as too dangerous. He says that even with the best technique the nerve is often missed. The sharp lightning pain is not an absolute indication of the entrance of the needle into the nerve, since the needle may strike the periosteum and give rise to similar pain. The abundant work done with nerve injections, Schlesinger says, has brought out two main facts. The first is that the beneficial effects of the injections are often very uncertain. The second is the deficient knowledge of the anatomical causes of neuralgic pain.

Use of Alkalies in Practical Medicine.—SMITH (*Brit. Med. Jour.*, 1909, i, 263) enumerates the various uses of the alkalies, especially their action in modifying the digestive functions. He believes that they must be used with discretion, for appropriate conditions, and on a definite plan. They should be used only in moderate doses, and should be immediately discontinued when their administration shows no definite beneficial effects. The alkalies have a local action on the stomach and intestinal tract, which, Smith believes, is due more to their influence in restoring the deranged functions of the gastric mucosa in catarrhal conditions than to their chemical action upon the gastric secretion. Besides this local action, Smith ascribes to the alkalies a more general effect upon the body metabolism.

In gastric disturbances, sodium and potassium bicarbonate seem to be equally good. Smith believes that the action of the alkalies is enhanced by the addition of a few grains of sodium chloride to each dose. If the stomach is very irritable, the alkalies should be made to effervesce with citric acid. The caustic alkalies—liquor potassæ and liquor sodæ—have a more marked sedative action upon the stomach than the bicarbonates. The heavy carbonates of magnesium or calcium carbonate are often useful. Smith advises the use of the insoluble alkalies for the purpose of neutralizing acid formed in the cecum. He thinks these are likely to pass unaltered through the stomach and reach the lower bowel unchanged. Smith also discusses the use of alkalies in the treatment of urinary acidity, in urinary sand or gravel, and in suppression of urine. He speaks of the beneficial effects in viscid bronchitis and of the value of sodium citrate in infant feeding.

Antibacterial or Antitoxic Immunization in Tuberculin Treatment.—TRUDEAU (*Jour. Amer. Med. Assoc.*, 1909, iv, 261) discusses the two widely differing theories of the mode of action of tuberculin therapy. One of these is the "vaccination" theory, which claims, as a result of the tuberculin treatment, a greater or less degree of a specific immunity to the tubercle bacillus itself. The "toxin immunization" theory holds that there results an immunity to the toxin of the tubercle bacillus. Trudeau believes that until more accurate knowledge is obtained of the mode of action of tuberculin, opinions will differ as to the best method to be employed. He also believes that neither theory is entirely satisfactory. He says that the production of a general antibacterial immunity is not supported by experimental evidence. On the other hand, in cases of purely localized tuberculous disease, in which the general health is unimpaired and there is no evidence of chronic toxemia, the use of tuberculin is often attended with good results. It is evident that this

result is not caused by an antitoxic action, though it may be due to many imperceptible focal reactions and not to a general specific immunity. For a working theory Trudeau prefers the conception of the production of an immunity that is principally antitoxic.

Trudeau concludes as follows: If we accept the toxin immunization conception as the essential feature and guide to the treatment, instead of measuring the degree of a questionable antibacterial immunity by the opsonic index, or attempting to produce it more or less empirically by a series of moderate reactions, the severity of which we cannot in any way control, the main features in our treatment would be: (1) To raise the degree of tolerance to tuberculin to the highest point attainable in each case by an almost imperceptible and long-continued progression in dosage. (2) To avoid general and focal reactions as much as possible and consider them merely as evidences of intolerance. (3) To follow no arbitrary rule as to rate of increase or the maximum dose to be reached, but to be guided merely by the degree of toxin tolerance of each patient as shown by the symptoms and general condition, whether the highest individual maximum dose attainable be only a small fraction of a milligram or a cubic centimeter or more.

The Treatment of Bronchial Affections by Raising the Foot of the Bed.—SCHÄFER (*Deutsch. Archiv, f. klin. Med.*, 1909, iii, iv, 376) gives a report of 29 cases of various forms of bronchial affection treated by raising the foot of the bed, as advocated by Quincke. The patients first lie flat in bed on the back with the head turned to one side. When they have become accustomed to this position, the foot of the bed is raised from eight to twelve inches for two or three hours every morning. In some of the cases, this procedure was also made use of in the evening. The patients were enabled to raise large amounts of sputum by this method, and during the remainder of the day had little or no cough and no expectoration. The fever resulting from the retained secretions rapidly subsided and the patients increased in weight. This method is especially valuable, Schäfer says, for all cases of bronchiectasis of the lower lobes and for the long-protracted cases of bronchitis in elderly people.

Combined Intravenous Arsenic and Tuberculin Therapy.—Wendell (*Münch. med. Woch.*, 1909, lii, 13) speaks of the good results obtained by the combined treatment with atoxyl and tuberculin. He advises Koch's old tuberculin in doses of $\frac{1}{100}$ to $\frac{1}{10}$ mgm. injected intravenously every eighth day. Atoxyl in gradually increasing doses from 0.05 gram to 0.3 gram is injected every second day. Wendel believes that the tuberculin causes a hyperemia about the areas of tuberculous infiltration, and that consequently atoxyl is brought in larger amounts to these areas. Therefore the atoxyl exerts its healing action at the site of the tuberculous process. In addition, the tuberculin aids by the production of antibodies. In the cases Wendel treated by this method he noticed both an improvement in the local process and in the general condition of the patient. He says that this plan of treatment is suitable not only for hospital cases, but also for ambulant cases without fever in the first or second stages of the disease.

The Treatment of Internal Hemorrhage by Sodium Chloride.—VON DEN VELDEN (*Deutsch.-med. Woch.*, 1909, v, 197) relates some interesting experiments upon animals and normal individuals, which seem to show that sodium chloride has a distinct influence in increasing the coagulability of the blood. He found that, after doses of from 5 to 15 grains of sodium chloride by mouth, there was an increase in the coagulability of the blood, reaching its maximum in from seven to fifteen minutes and persisting for from one to one and a half hours. He remarks that sodium chloride does not have this action in test-tube experiments, and attributes the increase in coagulability to a mobilization of the thrombokinase stored up in the tissues. Sodium chloride has long been a popular remedy for hemorrhage, and its beneficial effects have been ascribed to a hyperemia of the splanchnic area due to nausea. The author points out that in the doses he used, this nauseating action could largely be excluded; in fact, he tried to avoid any nauseating action. His clinical results support the experimental evidence. In 29 cases of hemoptysis he obtained excellent results by the administration of 5 grams of sodium chloride by mouth. It is interesting also to note that he obtained similar results by the use of bromides. With a recurrence of the hemorrhage, he repeats the sodium chloride or substitutes sodium or potassium bromide. In addition the bromides have a general sedative action. He keeps up the combined sodium chloride and bromide treatment in severe cases, giving from 20 to 30 grams of sodium chloride and from 12 to 15 grams of bromide during the day. The sodium chloride corrects any tendency to bromide poisoning. When it is essential not to irritate the gastro-intestinal tract, as in hemorrhage from the stomach or from typhoid ulcers, he prefers to give the sodium chloride by infusion. For this purpose he uses from 3 to 5 c.c. of a sterilized 10 per cent. solution. The intravenous method is also to be preferred, he says, to prolonged and large dosage by sodium chloride when there is a suspicion of an inefficiency of the kidneys. The author believes that this treatment is of no value in such hemorrhagic diseases as hemophilia which are not influenced by transitory increases in the coagulability of the blood.

A New Digitalis Preparation.—MÜLLER (*Münch. med. Woch.*, 1908, li, 2651) writes of the results obtained at the Heidelberg clinic by the use of digipuratum (Knoll). Digipuratum is an extract of the active principle of digitalis leaves. It may be obtained in tablet form, each tablet containing 0.1 gram, or in powder form. It is insoluble in cold water and acids, but easily soluble in dilute alkaline solutions. Müller advises its use in all cases of cardiac insufficiency, whether of valvular, vascular, or muscular origin. Its action is similar to that of other digitalis preparations, but it is lacking in most of the unpleasant secondary effects. The good effects are obtained generally after 1.2 grams given in doses of 0.3 to 0.4 gram per day. Sometimes its effects are not noticed until 2 to 2.5 grams have been given. Digipuratum is especially well borne by the stomach, and has none of the unpleasant gastro-intestinal symptoms of other preparations. When the remedy is to be used over a long period of time, 0.05 gram per day will be sufficient to continue the therapeutic effect of the drug.

PEDIATRICS.

 UNDER THE CHARGE OF

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Tuberculin Reaction, with Special Reference to the Auricular Reaction.—

V. TEDESCHI (*Archiv f. Kinderheilk.*, 1909, xlix, 190), writing under this title, states that the activity of the tuberculin is of more importance in the production of the specific tuberculin reaction than is usually believed; it is well known that the tuberculins are not identical, that they are not prepared in the same manner, that they do not produce reactions over the same periods of time, and that they are not equally active in the same degree of solubility. Of further importance in the tuberculin reaction are the age of the patient, the different types of tuberculosis, and the various intercurrent diseases, since even some of the tuberculous changes themselves have an influence on the intensity and appearance of the reaction. Another point of importance is whether the tuberculin is of animal or human origin. Using both simultaneously on the same patient, it has frequently occurred that one produces a positive, the other a negative reaction. Tedeschi, therefore, advises the employment of both types of tuberculin simultaneously, and considers it of paramount importance to improve the technique of the reaction. Calmette's procedure he considers too dangerous and too uncertain on account of the hyperemic state of most eyelids in lymphatic children. He prefers v. Pirquet's method, modifying it to some extent. He injects very minute, carefully measured quantities of tuberculin beneath the skin. While this improves the certainty of the results considerably, the looseness of the subcutaneous tissues makes the recognition of indurations difficult, especially if they are but slight. Various parts of the body were tried, the auricular tissues giving the best results, because of the density of the underlying structures and their vascularity. Tedeschi sums up his results as follows: The auricular reaction is as devoid of danger as the dermal reaction; it possesses fewer sources of error than the other methods, particularly the ocular reaction. It is preferable to the ordinary dermal reaction as the consequences of either too deep or too superficial incisions are prevented. The deeper infiltration is more easily made out than in other methods on account of the transparency of the structures, and is more evident to the touch on account of the cartilaginous base. The reaction is more accurate; it permits the measurement and judgment of the employed fluid, particularly in reference to the comparative quantities of tuberculin, and the weight and age of the patient.

Sulphur Water Cures in Children.—O. HEUBNER (*Therap. Monats.*, 1908, xxii, 605) sees no reason why children should not be permitted to drink mineral waters as well as adults, and particularly recommends sulphur water in the form of drink, gargle, or inhalation for the chronic

pharyngeal catarrhs of children. Such catarrhs, whether caused by adenoids, enlarged tonsils, or other conditions, are associated with loss of appetite, constipation, anemia, frequent vomiting, etc. The latter occurs in most instances during the process of eating. The teeth are usually carious, and the throat and back part of the tongue are covered with foul-smelling exudate, which does not yield to any of the treatments usually ordered for it. He advises sulphur water for these catarrhs, and says he has had excellent results. He orders a wineglassful at waking, a second one a half-hour later, and another during the evening hours; it is used cool, as its taste is then less objectionable. Adenoid growths must be removed to get the best results. The use of sulphur water has never been followed by bad consequences.

Experiments with Albulactin in Artificially Fed Children.—Albulactin is the albumin of cow's milk; it is of a pure white color and is readily soluble in water. If hydrochloric acid is added to ordinary diluted milk, a coarsely granular precipitate forms, which makes a firm deposit within a short time; if the acid is added to a 1 per cent. solution of albulactin, a finely granular precipitate is produced, just as in mother's milk; it remains so throughout digestion. J. CASSELL and H. KAMMITZER (*Archiv f. Kinderheilk.*, 1909, xlix, 168) added albulactin to the food of a number of children, most of whom were in good health, but somewhat poorly nourished; a few of the children were suffering from different diseases. The albulactin was dissolved in their food, and no difficulty was observed in feeding the children. In a number of instances the food was again withdrawn after a varying period of time and tested for reaction, free and combined acids. The results were equally good in the normal and the sick children. The general state of health always improved, even in the badly nourished infants; there was never any vomiting or diarrhea, nor did the urine ever contain albumin. The motor function of the stomach remained good with albulactin in all cases but one, in which dyspepsia resulted, due to a concentrated state of the cow's milk given the baby. The amount of free hydrochloric acid was normal in 5 of the 7 instances in which it was tested. The stomach contents removed in cases in which albulactin was added consisted of fine granules; the infant's stomach is more tolerant of these, and they distribute themselves better than the tough, coarse masses present when albulactin was not used. The weight of the children improved splendidly and the albulactin children had a better and rosier appearance than the others, their flesh becoming much firmer under its use.

Scarlet Fever Carriers.—C. HERRMAN (*Archives of Pediatrics*, 1909, xxvi, 112) believes that desquamation is an unimportant factor in the spread of scarlet fever. He has often seen desquamating children play with other children, who did not contract the disease. Infected rooms are much more commonly at the bottom of furthering the disease. Another factor is the throat of an individual not really ill with the disease, but acting as host to the microorganisms. The most important cause, however, lies with the patients themselves, who may retain the causal agent for a long time (even months) in the secretions and discharges of the nose, mouth, ear, etc. From 30 to 50 per cent. of con-

valescing scarlet fever patients have discharging noses and ears. Mild scarlet fever cases are often not diagnosed, but may still act as scarlet fever carriers through the discharges mentioned. Isolation should be strictly enforced during an epidemic, and the children of a family having a scarlet fever patient should not be permitted to attend school. Nasal and oral hygiene should be enforced; adenoids, tonsils, and carious teeth removed or treated. Disinfection of the premises after scarlet fever should never be neglected.

The Therapeutic Use of Tuberculin in the Tuberculosis of Children.—

A. SCHLOSSMANN (*Deut. med. Woch.*, 1909, xxxv, 289) has employed tuberculin in the treatment of a small number of tuberculous children. He states that tuberculin is a specific agent in the tuberculosis of children; it favors complete cures. Only when large doses are employed will the organism of the tuberculous child react to the drug by formation of antibodies. In beginning treatment with tuberculin he first endeavors to make the organism tolerant against the drug (period of small doses); during the longer period of treatment with larger doses in appropriate intervals the formation of antibodies should be assisted and made permanent. Ill results due to the tuberculin during the period of treatment with large doses were not observed.

Scarlet Fever following a Wound in the Foot.—F. VAN DER BOGERT (*Archives of Pediatrics*, 1909, xxvi, 126) reports the case of a boy, aged five years, who stepped on a "rusty" nail. After two weeks the wound had healed and the boy was again running around barefoot. On the sixteenth day the site of the injury was again inflamed; the inguinal glands of the corresponding side were inflamed, large, and painful. Within two days he developed a typical scarlet fever rash, a strawberry tongue, a typical angina, cultures from which showed no diphtheria organisms. The opposite inguinal glands were also enlarged by this time and the boy's temperature reached 104°. Albuminuria developed and epistaxis was noted several times. The wound in the foot broke down and pus from it contained a pure culture of streptococci, as did also the throat. The desquamation was typical. A younger sister also developed scarlet fever. The author believes that the scarlet fever virus entered the wound between the fourteenth and sixteenth day after the injury, during the time when the boy again walked barefoot. The incubation period was probably two to four days.

OBSTETRICS.

UNDER THE CHARGE OF

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The Surgical Treatment of the Umbilical Cord.—BALLANTYNE (*Brit. Med. Jour.*, April 17, 1909) draws attention to the risks of infection at the umbilicus in cases treated by the ordinary method of ligating

the umbilical cord. He quotes Keller's statistics, giving a mortality of 2 per cent. in children, due to umbilical infection during the first month of life. Ballantyne has found that in premature children the umbilical vessels close less promptly than in children at full term, and hence the risk of infection is greater. To overcome this, and to treat the cord by surgical methods, Ballantyne tried seven different plans of dealing with the cord. In the first method the cord was cut with scissors one and one-half inches from the umbilical ring, the foetal end grasped between the thumb and forefinger, the vessels ligated separately with No. 1 catgut, and the sheath of the cord stitched over the resulting stump with fine silk sutures. In cases so treated a dry, black scab formed at the umbilicus, the child recovered without jaundice, and apparently did well.

By the second method the clamp was applied to the cord one inch from the umbilicus, the stump was crushed, and the clamp removed without bleeding. The sheath was sewed over the stump with a continuous silk suture. No ligature was applied, as the pressure of the forceps had stopped the bleeding. This method gave good results, and seemed, if anything, better than the first method.

In the third experiment the sheath of the cord was cut through with a scalpel in a circular fashion, one and one-half inches from the umbilicus. The silk ligature was tied around the whole cord, and the cord cut short. The edges of the sheath were brought together with silk sutures. This method resulted well.

In the fourth method an effort was made to cut the sheath of the cord on the foetal side and secure the vessels, and then pull the reflected sheath over the vessels and stitch it in place. This was found difficult because of Wharton's jelly.

In the fifth method the cord was cut in a circular fashion, the vessels picked up separately with artery forceps and ligated with catgut. Some difficulty was found in the ligature slipping; the sheath was stitched over the stump, and, on the whole, the method resulted well.

In the sixth method the sheath of the cord was cut in a circular fashion near the umbilicus, the cord transixed with a needle and ligature, the two halves being separately tied. The cord was then cut outside of the ligature and the sheath stitched over. A small black scab formed at the umbilicus, but the result was good.

In the seventh method the cord was cut off flush with the skin of the umbilicus, and the skin surfaces were joined. A circular incision was made at the junction of the skin with the sheath of the cord. The vessels were separated from the jelly and tied separately. The cord was severed, and the edges of the skin were then united with catgut.

The operation required ten minutes. The stumps healed like ordinary surgical wounds in aseptic condition, no putrefactive changes occurred, the surfaces uniting by first intention. There seemed to be less than the usual risk of slipping of the ligatures, and hemorrhage. The only objections to this method were the time taken in doing the operation carefully and the fact that the medical attendant will be called upon to do this operation at a time when the mother's condition might demand his attention. There seems to be no good and sufficient reason why the umbilical stump should not be ligated and closed like any other surgical wound, and if this be done properly putrefactive changes need not occur, and union should result by first intention.

The Prevention of Puerperal Fever.—An editorial writer in the *British Medical Journal*, April 24, 1909, draws attention to the fact that no positive decision has yet been reached as to what may safely be done in the prevention of puerperal fever. Hofmeier's report of 10,000 cases at Würzburg shows 15.36 per cent. of abnormal cases; in 11.48 per cent. the temperature rose above 100.4°. Among the 10,000 women 9 died with puerperal infection, the mortality of the clinic being 0.04 per cent. Among these patients, vaginal examinations were made, but a thorough disinfection of the hands was practised by students and midwives, and the external genitals of the patients were also treated in an antiseptic manner. Henkel relies on hot water and alcohol to disinfect the hands, and the use of rubber gloves. Scanzoni, in 157 precipitate births, had 97 cases who had no vaginal examination before the expulsion of the child; 21.6 per cent. of these patients had fever. In 112 women delivered without contact from without 11.5 per cent. had fever. These cases indicate that the genital tract may contain sources of infection independent of the bacteria conveyed by examination.

Fibromyoma of the Pregnant Uterus Producing Occlusion of the Intestinal Tract.—BACHMETEW (*Zentralbl. f. Gynäk.*, No. 16, 1909) reports the case of a pregnant woman who had in the abdomen, evidently upon the uterus, a small tumor. When four or five months pregnant she suffered with severe pain in the left lower portion of the abdomen, extending down the left lower extremity. These pains were so severe that she entered the hospital. On examination a fibroid tumor complicating pregnancy was diagnosed. The patient suffered from obstinate constipation which could not be relieved. Vomiting and tympany developed, and upon examination under ether, stenosis of the bowel could be clearly made out. The uterus was emptied by dilatation with an elastic bag, followed by version and extraction. This, however, produced no relief and the abdomen was opened. The transverse colon was found adherent to the uterine fibroid, which was covered by omentum and mesentery, also adherent. In separating the adhesions the covering of the bowel was torn, and repaired by sutures. The tumor was removed and its pedicle ligated, and two small, subserous fibroids of the uterus were also removed. The appendix was found distended with fecal calculi and inflamed, and was removed. The patient made a good recovery. On examining the tumor it was found to be a fibromyoma of the uterus undergoing necrosis.

Complete Extraperitoneal Cesarean Section.—FREUND (*Zentralbl. f. Gynäk.*, No. 16, 1909) reports the case of a primipara having a flat rachitic pelvis with a true conjugate of 7 cm. A long transverse incision was made and the lower uterine segment exposed in the usual manner. The bladder was readily pushed out of the way, and the uterus opened in the median line. A full term child was readily delivered by forceps, and the placenta removed by Créde's method. The incisions were easily closed by sutures, the patient making an uninterrupted recovery, without drainage. He also reports a second case of a multipara with flat rachitic pelvis, upon whom the same operation was performed. An assistant was enabled so to manipulate the uterus as to bring it in the

most favorable position for incision, and also to assist by pressure in bringing the child into the uterine wound. There was some tendency to uterine relaxation, which yielded to injections of ergot. This patient also made a good recovery. In these operations no attempt was made to push the bladder out of the way by distending it with sterile fluid. The manipulation of the uterus, bringing it to a favorable position for section, was very useful, and rendered unnecessary the employment of instruments for holding the bladder out of the way and holding asunder the edges of the incision. The manipulation of the child's head to bring it into the incision was also useful.

The Toxemic Vomiting of Pregnancy.—HENDRY (*Jour. Obst. Gyn. Brit. Empire*, April, 1909) reports the case of a primigravida, aged nineteen years, admitted to the Liverpool Maternity Hospital with grave emaciation, moderate jaundice, a temperature of 97° F., a weak and thready pulse, 90 to 100, feeble heart sounds, a furred tongue, and oral and dental sordes. Vomiting was frequent without food. The child was living. The patient was in the twenty-eighth week of pregnancy. The urine was scanty; specific gravity 1020; acid; bile stained; containing albumin and mucus, but no casts. The patient was fed with milk and water, and the urine examined, finding urea 1.27 per cent.; ammonia with a percentage of urea of 14.7. Labor gradually developed; the amniotic liquid had a specific gravity of 1010, alkaline; was dark gold and yellow in color, and gave a reaction for bile upon examination. A seven months' foetus, not jaundiced, was spontaneously expelled. The patient made a gradual recovery, the percentage of urea rising and the percentage of ammonia decreasing. The ammonia varied in this case from 14.7 per cent., just before delivery, to 4.6 per cent. eight weeks after delivery. Leucin and tyrosin were absent. Acute yellow atrophy of the liver was excluded by the gradual onset of the condition, the slight jaundice, the absence of cerebral symptoms, the normal liver dulness, and the recovery of the patient. The infant lived but a few hours after delivery.

Bacterial Vaccines in the Treatment of Septic Infection.—OASTLER (*Amer. Jour. Obst.*, April, 1909) reports in detail a case of chronic sepsis steadily growing worse, treated by bacterial vaccines. In this case both Fallopian tubes were removed by median abdominal incision. This condition followed puerperal septic infection. The patient recovered after treatment continued for three and a half months. A second case of acute gangrenous appendicitis with thrombosis, pyemia, and abscess of the liver, recovered after several months' treatment. The third case of septic endometritis from criminal abortion also recovered. The conclusions reached by these cases are that apparently favorable results have been obtained by the vaccines of streptococcus, staphylococcus, *Bacillus coli communis*, *Bacillus mucosus*, and gonococcus. All but the gonococcus vaccines should be autogenous. The vaccines aid in combating the septic processes and are especially required when the blood shows a low leukocyte count with high polymorphonuclears. In violent cases of acute sepsis no resistance can be created and no effect is obtained. The positive phase is more often obtained than the negative. Blood cultures are generally negative. The wound

discharge increases soon after injection. The pulse remains rapid some time after the temperature falls, but as yet there have been no ill effects from the injection. The dosage is purely experimental. Too large a dose does harm, and small doses give better results than large. The site of injection and the frequency of injection can only be determined by trial. The following doses every fourth day were found beneficial: *Staphylococcus*, 160,000,000 to 325,000,000; *streptococcus*, 40,000,000 to 80,000,000; *Bacillus coli communis*, 40,000,000 to 150,000,000; *Bacillus mucosus* up to 110,000,000; *gonococcus* 6,000,000 to 80,000,000. If the negative phase appears, the injection should be delayed and the dosage reduced. The opsonic index is an uncertain indication. The best indication of the resisting power of the patient is the leukocyte count and the polymorphonuclear count.

The Position of the Urinary Bladder During the Latter Months of Pregnancy and Labor.—PARAMORE (*Jour. Obst. Gyn. Brit. Empire*, March, 1909) reviews the literature of this subject, and describes dissections of his own to determine the position of the urinary bladder during the latter months of pregnancy and labor. He concludes that during the latter months of pregnancy the bladder is already in part an abdominal organ, and that its transplantation is completed before the actual mechanism of delivery of the foetus is commenced. The bladder does not form a part of the pelvic floor in any way. As the child descends the other pelvic contents rise until the foetus comes upon the actual pelvic floor. For birth to occur the foetus must pass through the muscular tissues of the pelvis, and thus with the coccyx and anococcygeal ligament, support the pelvic viscera, preserve the intra-abdominal pressure, and perform the functions of the pelvic floor in securing rotation.

GYNECOLOGY.

UNDER THE CHARGE OF

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Atresia of the Vagina with Hematometra, Hematosalpinx, and Hematovarium.—A. BROTHERS (*Post-Graduate*, twenty-fifth anniversary volume, New York, 1908), taking a case as a basis, has prepared an elaborate paper on gynatresie, emphasizing the etiology and surgical treatment of the various modifications. He classifies the gynatresie as follows: (1) Primary blood-retention: from (a) malformations of Müller's ducts; (b) from adhesions acquired in embryonal or early infantile life. (2) Secondary blood-retention; (A) non-puerperal, (a) from traumatism (operations, neglected pessaries, injuries, etc.); (b) infections (scarlatina, smallpox, diphtheria, etc.); (c) natural (old age, atrophy, chronic catarrhal inflammations); (d) mechanical

(ball-valve tumors in the uterus, pressure of tumors at uterine cornua on tubes, uterine flexions, carcinoma, etc.); (B) puerperal inflammations with ulceration or gangrenous destruction of the cervical or vaginal mucosa. Fuld, in 1888, collected 65 cases of gynatresia with hematosalpinx, in which there was a mortality rate of 74 per cent. Of the 48 fatal cases, 9 died without operation. In 27 of the fatal operations the hematosalpinx occurred in a single genital canal. In the remaining 12 fatal cases the utero-vaginal canal was double. From 1888 to 1908 Brothers found recorded 164 cases of blood-retention associated with gynatresia, as follows: (1) Primary blood-retentions: (a) single genital canal, 80 cases; (b) double genital canal, 65 cases. (2) Secondary blood-retentions, 19 cases. In none of these did Brothers find a spontaneous rupture of a hematosalpinx with fatal peritonitis. Fuld found 3 cases of spontaneous rupture or evacuation of primary retention tumors with a successful outcome. It occurred through the obliterated area, or into the bladder or rectum or through the septum of a double uterus. Brothers found 7 others.

Uterine Fibromas Complicating Pregnancy.—GILLETTE (*Amer. Jour. Obst.*, 1908, lviii, 870) states that even very small fibroids of the uterus complicating pregnancy may be so situated as to become of lethal significance; that fibroid tumors of the uterus may disappear during or shortly subsequent to pregnancy; that not only pedunculated uterine fibromas, but interstitial ones as well, may be removed during pregnancy without interrupting the gestation; and that such operations should not be limited to the first half of pregnancy.

The Care of Patients after Abdominal Section, with Special Reference to the Period of Time They Should be Kept Recumbent.—FREDERICK (*Jour. Amer. Med. Assoc.*, 1908, li, 834) believes the wounds of abdominal section should be closed by absorbable suture material placed in tiers, and that the patient should be kept in bed from sixteen to twenty-one days. Reference is made to the absence of firm union in such wounds until two weeks have elapsed, to the exhausted state commonly noted as a result of the disease indicating the section being made, and to the advantage of prolonged rest in such condition.

Arteriosclerosis of the Uterus.—C. M. REES (*Amer. Jour. Obst.*, 1908, lviii, 748) states that a diagnosis of arteriosclerosis of the uterus is difficult to make, and can only be made when it is possible to exclude every other cause of hemorrhage from the uterus, and by microscopic examination of scrapings from the uterus, in which sclerosed capillaries are found, or, finally, from sections of such a uterus after its removal. Rees believes arteriosclerosis, as a definite cause of hemorrhage from the uterus, occurring in women between the ages of forty and fifty and among those who have borne children, is of greater importance than has generally been determined, and that in a fair proportion of cases the hemorrhages from the uterus are in themselves sufficient to endanger the life of a woman, and can be made to yield only to hysterectomy. Rees states further that, with the uncertainty of diagnosis even after examinations of a section from the cervix and scrapings from the uterus,

which show no evidence of malignancy, in women between the ages of forty and fifty who have borne children, and suffer with frequently recurring hemorrhages, hysterectomy is justified.

Cystocele.—I. S. STONE (*Amer. Jour. Obst.*, 1908, lviii, 953), after referring to the literature of the surgical treatment of cystocele, mentioning the material technical improvements contributed by Sanger, Hadra, Schauta, Wertheim, Watkins, Reynolds, Noble, Goffe, and others, gives details of the technique of the procedure he had independently evolved ten years or more ago. Free separation of the bladder from the cervix and vagina is the essential feature of the plan.

Genital Tuberculosis.—AUGUST MARTIN (*Jour. Amer. Med. Assoc.*, 1908, li, 968) advocates a careful search for bacilli in every case of genital tuberculosis and to depend absolutely upon the bacteriological diagnosis in order accurately to study the subject. Martin is convinced that 24.6 per cent. of the seriously diseased adnexa of patients in his clinic at Griefswald contained tubercle bacilli. The presence of clinical tests and even of tubercles was discarded as positive evidence of tuberculosis. The subconjunctival instillation of Pirquet-Calmette is regarded with much favor by Martin, who believes it is of special value in genital tuberculosis complicated by pregnancy.

OTOLOGY.

UNDER THE CHARGE OF

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The Pathological Anatomy of the Ear in Hereditary Syphilis.—ASAÏ (Kiobo), Wiesbaden, 1908. The material forming the basis of the author's brochure consisted in 20 foetal and two-months-old temporal bones. In the middle ear there was found merely vessel dilatation and cellular infiltration, with the exception of 6 cases in which there was evidence of an inflammatory process, a percentage not evidence of preponderance inluetie cases. In the labyrinth the nerve distributions were normal with the exception of one case, in which, presumably as the sequence of a foetal meningitis, there was cellular infiltration and connective tissue cells determinable between the ganglion cells; hemorrhage was determined in 7 of the petrous bones, but there was no evidence ofluetie changes in the vessel walls. In 25 per cent. the observed defective development of the petrous bone corresponded to the period of gestation, and, as a whole, the results obtained from the investigation were negative, a conclusion in accord with the clinical observations in hereditary syphilis that the aural manifestations of this disease are comparatively rare, and are mostly evidenced at the end of the first decade.

The Hyperemic Method of Bier in Otology.—THEODORE HEIMAN (*Ann. des mal. de l'or., etc.*, January, 1909) states that Bier, in his book on hyperemia as a remedial measure, published in 1907, reports 17 cases of acute mastoiditis, of which number 16 were completely cured by this method, the hearing becoming, eventually, practically normal, with one exception; opening of the mastoid process was indicated in all of the cases, and the minimum duration of the hyperemic treatment was three weeks. In the chronic cases there were two complete recoveries. In Heiman's paper, after a comprehensive review of the literature of the subject, including quotations from Bier, from Fröse, who regards the anatomical conditions as unfavorable, and from Isemer, who found, in the cases in which it was ultimately necessary to operate, an unusually extensive bony necrosis, the author reports 8 cases under his own observation, and draws the following conclusions: (1) The clinical observations upon the effects of hyperemia are as yet insufficient to afford definite conclusions as to its value in diseases of the ear. (2) In the application of hyperemia in recent, and moderate, acute inflammations of the middle ear, coincidently with a paracentesis of the drumhead, it is possible to retard and ameliorate the disease. (3) Hyperemia facilitates the diagnosis of the latent purulent centres in the mastoid and in the temporal bone; it is contra-indicated in the more serious cases and in those in which there is any indication of intracranial complication. (4) The dissipation of the intracranial symptoms, which follows the hyperemia, is not to be regarded in favor of its use, but rather as a disadvantage, from the point of view of diagnosis.

The Treatment of Acute Middle Ear Suppuration with Nipple-shaped Perforation, by Aspirating the Pus into the External Meatus.—O. MUCK (*Archives of Otology*, December, 1908) states that in 150 cases of acute middle ear suppuration he found 5 cases, in the subacute stage, with a pronounced cone-shaped enlargement surrounding the perforation in the posterior superior segment of the drumhead. In these 5 cases, varying from one to thirty years of age, with previous symptoms of recurrent pus retention, recovery was effected, in an average of eight days, under treatment by repeated application of suction through the external canal, the duration of each application and its frequency being limited by the appearance of sanguinolent discoloration of the aspired secretion. The causative condition of these nipple-shaped projections Muck refers rather to the loose connective tissue network between the incus, stapes, and the medial wall of the tympanum, toward the antrum, than to the general swelling of the tympanic mucosa. He advocates treatment by aspiration rather than by incision of the nipple or by counter-opening, as recommended by Schwartz, on the ground that repeated aspiration affords a more adequate relief, favors the corrective hyperemia of the swollen tissues, and minimizes the liability to narrowing of the nipple sinus by epidermal involution. This method of treatment is inapplicable in cases in which involvement of the mastoid is evidenced.

HYGIENE AND PUBLIC HEALTH.

UNDER THE CHARGE OF

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The Purification of Drinking Water with Ozone.—ERLWEIN (*Bericht über den XIV Internationalen Kongress. f. Hyg. und Demog.*, 1908, iii, 195) enters quite fully into a discussion of this subject. The first attempt to sterilize water with ozone was made in 1889 with an apparatus manufactured by Siemens and Halske in Berlin, and was reported by Fröhlich; although this experiment was quite a success, the method was not pushed. In 1893 the ozonization of water was taken up by the late Baron Tindal, of Holland, and exhibits of the machinery were made at Brussels and Paris in 1895, and again in 1897. A bacteriological study of the water purified by Tindal's apparatus was made by van Ermengem. Since Tindal's death his method has been modified and developed by Frise. Other modifications of this method of purifying drinking water have been made by Abraham and Marmier and Otto in France, and by Vosmaer in Holland, while in 1898 the Siemens and Halske apparatus in Berlin was again put into operation. Erlwein presents a valuable chronological development of the ozonization of drinking water, but his special report is devoted to the study of the process as carried out at Wiesbaden and Paderborn. In these places the apparatus is that of Siemens and Halske. The plant at Wiesbaden is only contributory to a larger supply, and furnishes 250 cubic meters of water per hour, but it is not run continuously. The water from the plant has been carefully studied both chemically and bacteriologically at the Fresenius laboratory, and the results have been found to be satisfactory when the apparatus is not overworked. The Paderborn plant has been in operation for five years, and supplies from 80 to 90 cubic meters per hour. The water supply of this village is at certain times of the year quite satisfactory, but it is quickly and greatly polluted by rains; and two typhoid epidemics, one in 1895 and the other in 1898, caused the authorities to seek some method of purification. The plant was installed in 1902, and there has been no typhoid fever since, at least no epidemics. The ozonized water taken at a distance of 50 meters from the ozonizing tower gives no ozone reaction, has no unpleasant odor or taste, and does not corrode the water pipes. The cost of the process is 2.5 pfennigs per cubic meter, but Erlwein states that with a larger plant this might be reduced to 1 or 0.5 pfennig. Costly repair has not been necessary. The number of bacteria per cubic centimeter in the raw water varies from 100 to 5000, and that in the ozonized water from 0 to 22.

At the same Congress, Courmont and Lacomme (*Ibid.*, 215) report on this method of water purification as practised in France. In this country the methods are three, that of Frise, Otto, and Abraham, and Marmier. The first is in operation at Saint Maur, in Paris. The water is that of the Marne, and this is clarified by coarse filtration before

being ozonized. It requires 35 kilowatts per 1000 cubic meters. Two grams of ozone per cubic meter of air, and 30 c.m. of air to 40 c.m. of water are used. This is equivalent to 0.6 gram of ozone per 1000 c.c. of water. The discharge is 108 c.m. per hour. The cost is 0.015 francs per cubicmeter. The result is excellent physically, chemically, and bacteriologically. The ozonized water is clear, of good taste, without odor, and shows no appreciable chemical alteration, no nitrite, and no increase in nitrate. Before filtration the number of bacteria was found to be 4000 with many coli; after, it was 7 with no coli, showing a reduction of 99.8 per cent. The Otto system has been in operation at Nice since 1903. The requirement is 0.5 gram of ozone per cubicmeter of water. The chemical composition is not modified except that the organic matter is reduced. The number of bacteria is reduced per cubic centimeter from 2000 to 1.4, with total disappearance of coli. The cost is 0.005 francs per cubicmeter, this very low cost being due to the fact that the electricity is generated by water power. The process of Abraham and Marnier is in operation at Lille. The quantity of ozone used amounts to from 4 to 6 grams per cubicmeter. A commission, of which Calnette and E. Roux were members, investigated this process and reported that it is quite satisfactory. The raw water contained 1517 bacteria per cubic centimeter, and the ozonized 0.03, *Bacillus subtillis* being the only organism that escaped. The same method is in operation at Cosne-sur-Loire, and is satisfactory there also.

[It seems evident from the above that the purification of drinking water for municipalities by ozonization is of much promise. The methods will doubtlessly be improved from time to time. Its applicability to waters containing much organic matter in addition to the living organisms, is a matter that will need more extended study. When this matter is in suspension it can be easily removed by coarse filtration, but when in solution one would expect that ozonization in order to be efficient would be much more costly than the above given figures indicate.—V. C. V.]

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